

# **Marine Fish and Invertebrate Atlas: Summarizing Geographic Distribution and Population Indices in the Scotian Shelf and Bay of Fundy (1970-2020)**

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POPULATION INDICES AND ENVIRONMENTAL PREFERENCES IN THE SCOTIAN SHELF  
AND BAY OF FUNDY (1970-2020)

by

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## **ABSTRACT**

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The summer groundfish research vessel survey on the Scotian Shelf and in the Bay of Fundy started in 1970 and was designed to measure the distribution and abundance of major commercial fish species. Over time, additional information on non-commercial species was collected, and allowed considerable insight into ecosystem function and structure, as documented in many primary publications whose analyses used the survey data. The same groundfish survey database has also been used to produce species status reports, atlases of species distribution and remains an essential source of information for stock assessments in the Maritimes Region of Fisheries and Oceans Canada. This report builds on previous work and former atlases by updating a comprehensive suite of indices to assess population status and environmental preferences of 104 species. For each species, trends in geographic distribution and biomass or abundance were plotted. The spatial extent of distribution was plotted over time to gauge how the area occupied has changed. The relationship between abundance or biomass and spatial extent reflected whether the species distribution expands when abundance or biomass increases. Length frequencies over time depicted any changes in mean size. The plots of condition over time revealed whether individual fish are fatter or thinner than their long term mean. Depth, temperature and salinity preferences were estimated to gauge the range of suitable environmental parameters for each species. Finally, for each stratum, the slope describing how local density varies with regional abundance was estimated.

## RÉSUMÉ

Ricard, D. and Gomez, C. 2021. Marine Fish and Invertebrate Atlas: Summarizing Geographic Distribution, Population Indices and Environmental Preferences in the Scotian Shelf and Bay of Fundy (1970-2020). Can. Tech. Rep. Fish. Aquat. Sci. nnn: ix + 157 p.

Voici le résumé. Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

## 1 Introduction

The summer (July-August) groundfish research vessel survey on the Scotian Shelf and in the Bay of Fundy was started in 1970 by Fisheries and Oceans Canada Maritimes Region. The survey was originally designed to measure the distribution and abundance of major commercial fish species. Over time, information on non-commercial species was also collected. The groundfish survey database storing the information collected during the annual survey provides the main source of fisheries-independent information for marine species in the region. This information is routinely used to support stock assessments, to produce species status reports and has been previously used to publish atlases of species distribution.

The current document is an update of an earlier report (Ricard and Shackell 2013) that built on former atlases by updating a comprehensive suite of derived indices for 104 species to assess population status and environmental preferences. The information collected during the survey is stored in a relational database management system archived at Fisheries and Oceans Canada Maritimes Region which contains detailed information about the sampling locations and the associated catch. Tow-level survey data is also publicly available from the Ocean Biogeographic Information System (DFO 2016) and ([FGP link TBA](#)). The present atlas follows on the work done by Fisheries and Oceans colleagues from the northern Gulf of St. Lawrence (Bourdages and Ouellet 2012), southern Gulf of St. Lawrence (Benoît et al. 2003) and on earlier work in the Scotian Shelf (Simon and Comeau 1994; Horsman and Shackell 2009).

To facilitate updates and foster collaboration on the analyses of the survey data, the computer code necessary to extract the data, to perform the analyses presented herein, and to reproduce and update the current document is made available in a git repository (Ricard and Gomez 2021).

The survey area covers three major Northwest Atlantic Fisheries Organization (NAFO) zones that divide the shelf into the colder east 4V and 4W (strata 440-466) and warmer west 4X (strata 470-495). Temporal trends are plotted by NAFO regions for several species. For each species, trends in geographic distribution and biomass or abundance are plotted. Some caution is required in interpreting the results obtained for several taxa due to low sample size as explained later in the text. The spatial extent of distribution is plotted over time to gauge how the area occupied has changed. The relationship between biomass and spatial extent reflects whether the species distribution expands when biomass increases. For each strata, the slope describing how local density varies with regional abundance was estimated (Myers and Stokes 1989). These slopes were then plotted against a habitat suitability index to identify important strata for each species. Then, length frequencies over time depicted any changes in mean size. The plots of condition over time revealed whether individual fish are fatter or thinner than their long term mean. Finally, depth, temperature and salinity preferences were estimated to gauge the range of environmental parameters (Perry and Smith 1994). A full ecological interpretation of trends is beyond the scope of this report. Other documents stemming from peer-reviewed scientific processes under the auspices of the [Canadian Science Advisory Secretariat](#) (CSAS) provide further descriptions of spatio-temporal trends in different indicators and put the information collected during the summer groundfish research vessel survey in a more focused context (see for example Clark and Emberley (2011)).

## 2 Methods

### 2.1 Survey Description

The survey is conducted annually in July-August and covers the Scotian Shelf and the Bay of Fundy (Figure 1). It normally involves two separate two-week trips on board an offshore fisheries vessel from the Canadian Coast Guard.

A number of changes in fishing gear type and vessels used occurred since the onset of sampling activities (Clark and Emberley 2011).

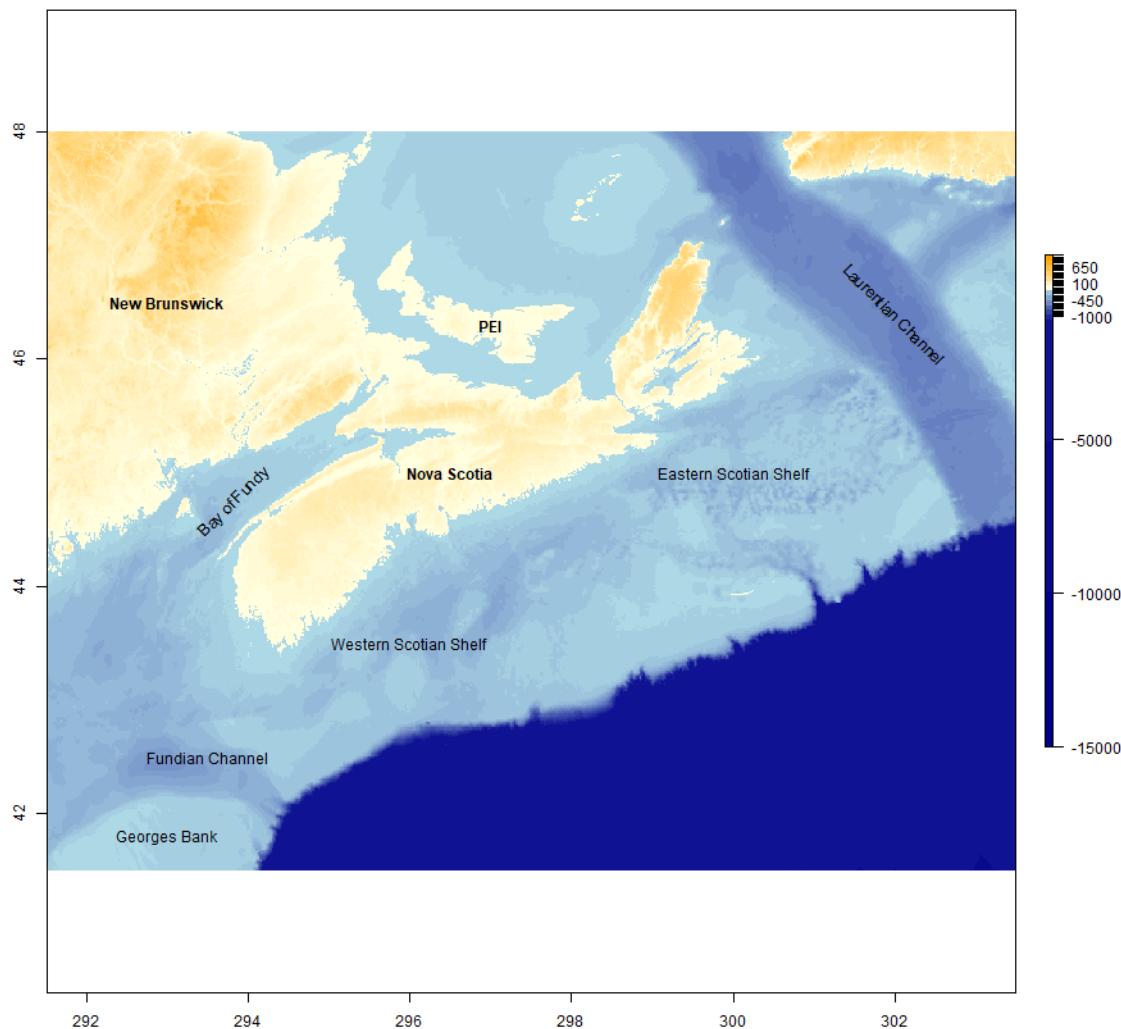


Figure 1. Map of the Scotian Shelf and Bay of Fundy.

## 2.2 Sampling Design

The summer survey covers divisions 4V, 4W and 4X of the Northwest Atlantic Fisheries Organization (NAFO) which includes the Scotian Shelf and the Bay of Fundy. The eastern limit of the survey is the Laurentian Channel and the western limit is the Fundian Channel (Figure 1).

The survey follows a stratified random design (Doubleday and Rivard 1981; Lohr 1999) (Figure 2). The number of tows conducted in each stratum is approximately proportional to its surface area.

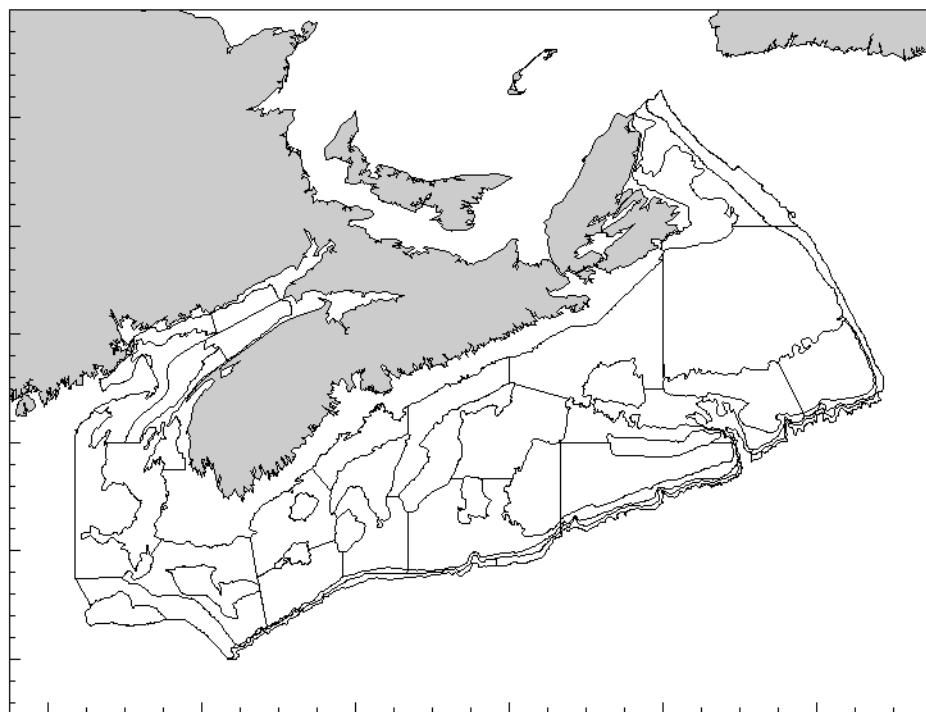


Figure 2. Map of the Summer survey strata.

The basic sampling unit of the survey is a 30-minute fishing tow conducted at a speed of 3.5 knots. This yields a distance towed of 1.75 nautical miles.

After each tow the catch is sorted by species and weighed. Each fish caught is then measured, and further sampling of individual fish weight, maturity status and age are performed for different length classes. When catches exceed 300 individuals, a random sub-sample is used to obtain the length and weight measurements.

The location of representative tows appears in Figure 3.

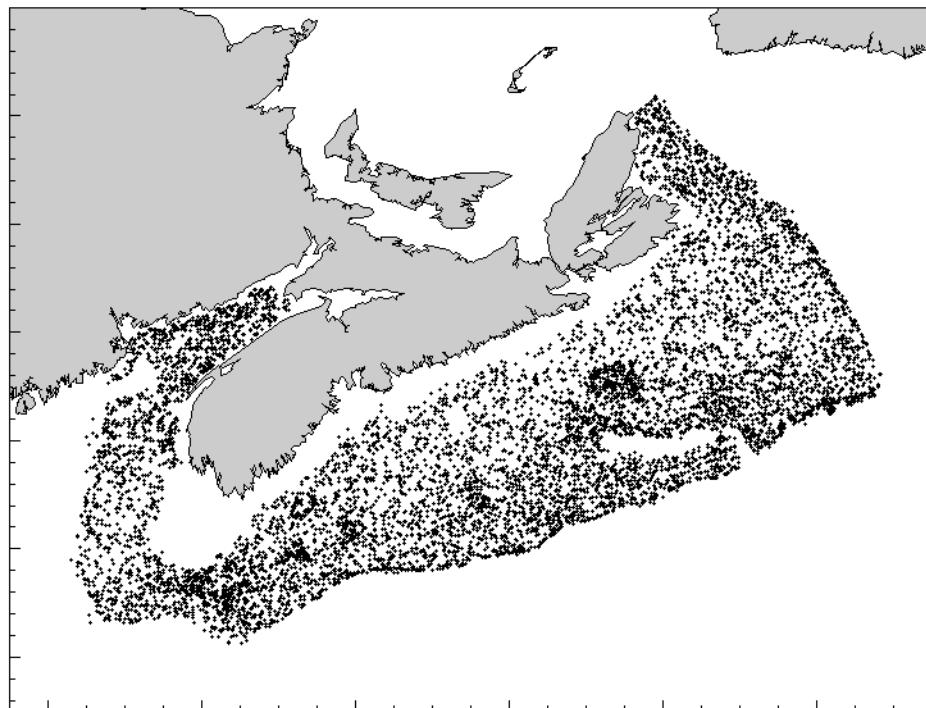


Figure 3. Map of the Summer survey tows.

### 2.3 Taxonomic Levels

Fish species caught during the surveys are identified by trained scientific personnel and their scientific name is determined. An internal species code used in the relational database is reported for each species (Losier and Waite 1989).

By its nature as a bottom trawl, the fishing gear used in the survey catches certain species better than others. To ensure that meaningful ecological information can be extracted from catch samples, we report the catch records for the subset of species that are caught reliably by the gear. To appear in this atlas, a species must have had a minimum of 10 observations over the duration of the survey activities. While both catch abundance and weight are recorded, the weight of species that appear at low abundances is often recorded as zero in the earlier parts of the survey when scales of appropriate precision were not available.

We divided the species caught into five categories based on 1) their taxonomic classification, 2) the number of recorded observations, and 3) their period of valid identification (Table 1). Category "LF", for "long frequent", was assigned to species that have more than 1000 records since 1970 and have been consistently identified since the onset of the survey. Category "LI", for "long intermediate", was assigned to species that had between 1000 and 200 catch records. Rare and elusive species (those with less than 200 catch records over the duration of the survey) are also reported but to a lower level of analytical details (Category "LR", for "long rare"). Category "SF", for "short frequent", was assigned to invertebrate species that were consistently sampled only since 1999 (Tremblay M. J. 2007). And category "SR", for "short rare" for invertebrate species consistently sampled only since 1999 and with less than 200 catch records. The list of taxa covered in this document is presented in phylogenetic order (Nelson J. S. et al. 2004) in Table 2. To ensure concordance with authoritative taxonomic information, the AphiaID from the World Register of Marine Species is also provided in Table 2 (Appeltans et al. 2012).

<b>Category</b>	<b>Name</b>	<b>Description</b>
L	long - consistently identified since the onset of the survey in 1970	
LF	long frequent	species that have more than 1000 catch records
LI	long intermediate	species that had between 1000 and 200 catch records
LR	long rare	species with less than 200 catch records
S	short - invertebrate species that were consistently sampled only since 1999	
SF	short frequent	species with more than 200 catch records
SR	short rare	species with less than 200 catch records

Table 1. Taxonomic levels

Table 2. List of species included in the Atlas. The species reported here are listed in phylogenetic order as per Page L. M. et al. (2013). For each taxonomic order and class, each species is listed in the table, its taxonomic family and scientific name is provided, along with its French and English common names, the species code used in the survey database, its AphiaID and a link to the World Registry of Marine Species, its number of catch records in the survey database and its classification category as defined in section 2.3.

	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
<b>Myxini</b>								
<i>Myxiniformes</i>								
	Myxinidae	<i>Myxine glutinosa</i>	Atlantic hagfish	Myxine du nord	241	<a href="#">101170</a>	804	LI
<b>Petromyzonti</b>								
<i>Petromyzontiformes</i>								
	Petromyzontidae	<i>Petromyzon marinus</i>	Sea lamprey	Lamproie marine	240	<a href="#">101174</a>	16	LR
<b>Actinopterygii</b>								
<i>Gadiformes</i>								
♂	Gadidae	<i>Gadus morhua</i>	Atlantic cod	Morue franche	10	<a href="#">126436</a>	5451	LF
		<i>Melanogrammus aeglefinus</i>	Haddock	Aiglefin	11	<a href="#">126437</a>	5827	LF
	Phycidae	<i>Urophycis tenuis</i>	White hake	Merluche blanche	12	<a href="#">126504</a>	3524	LF
		<i>Urophycis chuss</i>	Red hake	Merluche écureuil	13	<a href="#">126503</a>	2195	LF
	Merlucciidae	<i>Merluccius bilinearis</i>	Silver hake	Merlu argenté	14	<a href="#">158962</a>	4936	LF
	Lotidae	<i>Brosme brosme</i>	Cusk	Brosme	15	<a href="#">126447</a>	688	LI
	Gadidae	<i>Pollachius virens</i>	Pollock	Goberge	16	<a href="#">126441</a>	2787	LF
		<i>Microgadus tomcod</i>	Atlantic tomcod	Poulamon atlantique	17	<a href="#">158928</a>	44	LR
	Merlucciidae	<i>Merluccius albidus</i>	Offshore silver hake	Merlu argenté du large	19	<a href="#">158748</a>	161	LR
<i>Scorpaeniformes</i>								
	Sebastidae	<i>Sebastes</i>	Atlantic redfishes	Sébastes de l'Atlantique	23	<a href="#">126175</a>	4152	LF
<i>Pleuronectiformes</i>								
	Pleuronectidae	<i>Hippoglossus hippoglossus</i>	Atlantic halibut	Flétan de l'Atlantique	30	<a href="#">127138</a>	1634	LF

Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
Pleuronectidae	<i>Reinhardtius hippoglossoides</i>	Greenland halibut	Flétan noir	31	<a href="#">127144</a>	736	LI
	<i>Hippoglossoides platessoides</i>	American plaice	Plie canadienne	40	<a href="#">127137</a>	6023	LF
	<i>Glyptocephalus cynoglossus</i>	Witch flounder	Plie grise	41	<a href="#">127136</a>	4301	LF
	<i>Limanda ferruginea</i>	Yellowtail flounder	Limande à queue jaune	42	<a href="#">158879</a>	3233	LF
	<i>Pseudopleuronectes americanus</i>	Winter flounder	Limande-plie rouge	43	<a href="#">158885</a>	1632	LF
Paralichthyidae	<i>Citharichthys arctifrons</i>	Gulf Stream flounder	Plie du Gulf Stream	44	<a href="#">158791</a>	382	LI
<i>Perciformes</i>							
Anarhichadidae	<i>Anarhichas lupus</i>	Atlantic wolffish	Loup atlantique	50	<a href="#">126758</a>	1572	LF
	<i>Anarhichas minor</i>	Spotted wolffish	Loup tacheté	51	<a href="#">126759</a>	20	LR
	<i>Anarhichas denticulatus</i>	Northern wolffish	Loup à tête large	52	<a href="#">126757</a>	17	LR
<i>Clupeiformes</i>							
Clupeidae	<i>Clupea harengus</i>	Atlantic herring	Hareng de l'Atlantique	60	<a href="#">126417</a>	3487	LF
	<i>Alosa sapidissima</i>	American shad	Alose savoureuse	61	<a href="#">158670</a>	468	LI
	<i>Alosa pseudoharengus</i>	Alewife	Gaspareau	62	<a href="#">158669</a>	977	LI
<i>Osmeriformes</i>							
Osmeridae	<i>Osmerus mordax</i>	Rainbow smelt	Éperlan arc-en-ciel	63	<a href="#">126737</a>	59	LR
	<i>Mallotus villosus</i>	Capelin	Capelan	64	<a href="#">126735</a>	540	LI
<i>Perciformes</i>							
Scombridae	<i>Scomber scombrus</i>	Atlantic mackerel	Maquereau commun	70	<a href="#">127023</a>	696	LI
<i>Gadiformes</i>							

	Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category	
	Phycidae	<i>Phycis chesteri</i>	Longfin hake	Merluche à longues nageoires	112	<a href="#">158988</a>	784	LI	
	Lotidae	<i>Enchelyopus cimbricus</i>	Fourbeard rockling	Motelle à quatre barbillons	114	<a href="#">126450</a>	693	LI	
<i>Perciformes</i>	Labridae	<i>Tautogolabrus adspersus</i>	Cunner	Tanche-tautogue	122	<a href="#">159785</a>	82	LR	
	Sebastidae	<i>Helicolenus dactylopterus</i>	Blackbelly rosefish	Sébaste chèvre	123	<a href="#">127251</a>	610	LI	
∞	<i>Pleuronectiformes</i>	Paralichthyidae	<i>Hippoglossina oblonga</i>	Fourspot flounder	Cardeau à quatre ocelles	142	<a href="#">158833</a>	76	LR
		Scophthalmidae	<i>Scophthalmus aquosus</i>	Windowpane flounder	Turbot de sable	143	<a href="#">158907</a>	115	LR
	<i>Aulopiformes</i>	Chlorophthalmidae	<i>Parasudis truculenta</i>	Longnose greeneye	Oeil-vert à long nez	149	<a href="#">158868</a>	45	LR
		Myctophidae	<i>Myctophidae</i>	Lanternfishes	Poissons-lanternes	150	<a href="#">125498</a>	160	LR
	<i>Aulopiformes</i>	Chlorophthalmidae	<i>Chlorophthalmus agassizi</i>	Shortnose greeneye	Éperlan du large	156	<a href="#">126336</a>	78	LR
		Sternopychidae	<i>Maurolicus muelleri</i>	Silvery lightfish	Brossé améthyste	158	<a href="#">127312</a>	52	LR
	Stomiidae	<i>Stomias boa</i>	Boa dragonfish	Dragon-boa	159	<a href="#">127374</a>	20	LR	
<i>Argentiniformes</i>	Argentinidae	<i>Argentina silus</i>	Greater argentine	Grande argentine	160	<a href="#">126715</a>	963	LI	
	<i>Scorpaeniformes</i>	Cottidae	<i>Myoxocephalus octodecemspinosus</i>	Longhorn sculpin	Chabosseau à dix-huit épines	300	<a href="#">159520</a>	3292	LF

Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
	<i>Myoxocephalus scorpius</i>	Shorthorn sculpin	Chabosseau à épines courtes	301	<a href="#">127203</a>	131	LR
	<i>Myoxocephalus aenaeus</i>	Grubby	Chabosseau bronzé	303	<a href="#">159519</a>	40	LR
	<i>Triglops murrayi</i>	Moustache sculpin	Faux-trigle armé	304	<a href="#">127205</a>	1182	LF
	<i>Arctediellus uncinatus</i>	Arctic hookear sculpin	Hameçon neigeux	306	<a href="#">127195</a>	306	LI
Psychrolutidae	<i>Cottunculus microps</i>	Polar sculpin	Cotte polaire	307	<a href="#">127235</a>	29	LR
Cottidae	<i>Icelus spatula</i>	Spatulate sculpin	Icele spatulée	314	<a href="#">127200</a>	40	LR
Hemitripteridae	<i>Hemitripterus americanus</i>	Sea raven	Hémithriptère atlantique	320	<a href="#">159518</a>	2126	LF
Agonidae	<i>Aspidophoroides monopterygius</i>	Alligatorfish	Poisson-alligator atlantique	340	<a href="#">159459</a>	1029	LF
	<i>Ulcina olrikii</i>	Arctic alligatorfish	Poisson-alligator arctique	341	<a href="#">274356</a>	13	LR
	<i>Leptagonus decagonus</i>	Atlantic poacher	Agone atlantique	350	<a href="#">127191</a>	266	LI
	<i>Agonidae</i>	Alligatorfishes	Poissons-alligator	351	<a href="#">125588</a>	43	LR
<i>Lophiiformes</i>							
Lophiidae	<i>Lophius americanus</i>	Monkfish	Baudroie d'Amérique	400	<a href="#">159184</a>	1970	LF
<i>Gadiformes</i>							
Macrouridae	<i>Nezumia bairdii</i>	Marlin-spike grenadier	Grenadier du Grand Banc	410	<a href="#">183289</a>	529	LI
	<i>Trachyrincus murrayi</i>	Roughnose grenadier	Grenadier-scie	412	<a href="#">126481</a>	18	LR
	<i>Coryphaenoides rupestris</i>	Roundnose grenadier	Grenadier de roche	414	<a href="#">158960</a>	17	LR
<i>Scorpaeniformes</i>							
Cyclopteridae	<i>Cyclopterus lumpus</i>	Lumpfish	Lompe	501	<a href="#">127214</a>	216	LI

Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
	<i>Eumicrotremus spinosus</i>	Atlantic spiny lump sucker	Petite poule de mer atlantique	502	<a href="#">127217</a>	226	LI
Liparidae	<i>Liparis atlanticus</i>	Atlantic seasnail	Limace atlantique	503	<a href="#">159524</a>	34	LR
	<i>Liparis fabricii</i>	Gelatinous snailfish	Limace gélatineuse	505	<a href="#">127218</a>	27	LR
	<i>Liparis gibbus</i>	Variegated snailfish	Limace marbée	512	<a href="#">159526</a>	41	LR
	<i>Careproctus reinhardtii</i>	Sea tadpole	Petite limace de mer	520	<a href="#">127212</a>	18	LR
<i>Perciformes</i>							
Zoarcidae	<i>Lycenchelys verrillii</i>	Wolf eelpout	Lycode à tête longue	603	<a href="#">159258</a>	40	LR
<i>Anguilliformes</i>							
Nemichthyidae	<i>Nemichthys scolopaceus</i>	Slender snipe eel	Avocette ruban	604	<a href="#">126306</a>	28	LR
<i>Perciformes</i>							
Ammodytidae	<i>Ammodytes dubius</i>	Sand lance	Lançon	610	<a href="#">151520</a>	1283	LI
Zoarcidae	<i>Lycodes terraenovae</i>	Newfoundland eelpout	Lycode du Labrador	619	<a href="#">127117</a>	64	LR
	<i>Lycodes lavalaei</i>	Newfoundland eelpout	Lycode du Labrador	620	<a href="#">127107</a>	72	LR
Pholidae	<i>Pholis gunnellus</i>	Rock gunnel	Sigouine de roche	621	<a href="#">126996</a>	21	LR
Stichaeidae	<i>Lumpenus lampretaeformis</i>	Snakeblenny	Lompénie-serpent	622	<a href="#">154675</a>	423	LI
	<i>Leptoclinus maculatus</i>	Daubed shanny	Lompénie tachetée	623	<a href="#">127072</a>	443	LI
	<i>Ulvaria subbifurcata</i>	Radiated shanny	Ulvaire deux-lignes	625	<a href="#">159821</a>	145	LR
	<i>Eumesogrammus praecisus</i>	Fourline snakeblenny	Quatre-lignes atlantique	626	<a href="#">159817</a>	40	LR
Cryptacanthodidae	<i>Cryptacanthodes maculatus</i>	Wrymouth	Terrassier tacheté	630	<a href="#">159675</a>	120	LR
Callionymidae	<i>Foetorepus agassizii</i>	Spotfin dragonet	Dragonnet tacheté	637	<a href="#">276339</a>	20	LR

Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category	
Zoarcidae	<i>Zoarces americanus</i>	Ocean pout	Loquette d'Amérique	640	<a href="#">159267</a>	1478	LF	
	<i>Lycodes reticulatus</i>	Arctic eelpout	Lycode arctique	641	<a href="#">127112</a>	70	LR	
	<i>Melanostigma atlanticum</i>	Atlantic soft pout	Molasse atlantique	646	<a href="#">127120</a>	43	LR	
	<i>Lycodes vahlii</i>	Vahl's eelpout	Lycode à carreaux	647	<a href="#">127118</a>	565	LI	
Stromateidae	<i>Peprilus triacanthus</i>	Atlantic butterfish	Stromaté fossette	701	<a href="#">159828</a>	487	LI	
Zeiformes	Zeidae	<i>Zenopsis conchifer</i>	Silvery John dory	Saint Pierre argenté	704	<a href="#">127426</a>	39	LR
Aulopiformes	Paralepididae	<i>Arctozenus risso</i>	White barracudina	Lussion blanc	712	<a href="#">126352</a>	196	LR
Beloniformes	Scomberesocidae	<i>Scomberesox saurus</i>	Atlantic saury	Balaou atlantique	720	<a href="#">126392</a>	37	LR
Stomiiformes	Sternopychidae	<i>Sternopychidae</i>	Hatchetfishes	Haches d'argent	741	<a href="#">125603</a>	21	LR
Lophiiformes	Ogcocephalidae	<i>Dibranchus atlanticus</i>	Atlantic batfish	Malthe atlantique	742	<a href="#">126558</a>	18	LR
Pleuronectiformes	Cynoglossidae	<i>Symphurus diomedeanus</i>	Spottedfin tonguefish	Langue fil noir	816	<a href="#">159358</a>	24	LR
Scorpaeniformes	Cottidae	<i>Artediellus atlanticus</i>	Atlantic hookear sculpin	Hameçon atlantique	880	<a href="#">127193</a>	258	LI
<b>Elasmobranchii</b>								
Rajiformes	Rajidae	<i>Dipturus laevis</i>	Barndoor skate	Grande raie	200	<a href="#">158548</a>	246	LI
		<i>Amblyraja radiata</i>	Thorny skate	Raie épineuse	201	<a href="#">105865</a>	3937	LF
		<i>Malacoraja senta</i>	Smooth skate	Raie lisse	202	<a href="#">158554</a>	1773	LF

Family	Scientific name	English name	French name	Species code	AphiaID	Num. records	Category
<i>Squaliformes</i>	<i>Leucoraja erinacea</i>	Little skate	Raie hérisson	203	<a href="#">158551</a>	712	LI
	<i>Leucoraja ocellata</i>	Winter skate	Raie tachetée	204	<a href="#">158553</a>	1180	LF
<i>Squalidae</i>	<i>Squalus acanthias</i>	Picked dogfish	Aiguillat commun	220	<a href="#">105923</a>	1985	LF
	<i>Centroscyllium fabricii</i>	Black dogfish	Aiguillat noir	221	<a href="#">105906</a>	31	LR
<b>Cephalopoda</b>							
<i>Oegopsida</i>							
Ommastrephidae	<i>Illex illecebrosus</i>	Northern shortfin squid	Encornet rouge nordique	4511	<a href="#">153087</a>	4836	LF
<i>Myopsida</i>							
Loliginidae	<i>Doryteuthis pealeii</i>	Longfin inshore squid	Calmar totam	4512	<a href="#">574541</a>	96	LR
<b>Malacostraca</b>							
<i>Decapoda</i>							
Pandalidae	<i>Pandalus borealis</i>	Northern prawn	Crevette nordique	2211	<a href="#">107649</a>	718	SF
Cancridae	<i>Cancer borealis</i>	Jonah crab	Tourteau jona	2511	<a href="#">158056</a>	1387	SF
	<i>Cancer irroratus</i>	Atlantic rock crab	Tourteau poïnclos	2513	<a href="#">158057</a>	788	SF
Oregoniidae	<i>Hyas coarctatus</i>	Arctic lyre crab	Crabe Hyas coarctatus	2521	<a href="#">107323</a>	711	SF
Lithodidae	<i>Lithodes maja</i>	Atlantic king crab	Crabe épineux du nord	2523	<a href="#">107205</a>	531	SF
Oregoniidae	<i>Chionoecetes opilio</i>	Queen crab	Crabe des neiges	2526	<a href="#">107315</a>	1546	SF
	<i>Hyas araneus</i>	Great spider crab	Crabe lyre araignée	2527	<a href="#">107322</a>	625	SF
Geryonidae	<i>Chaceon quinquedens</i>	Red deepsea crab	Crabe rouge	2532	<a href="#">158407</a>	33	SR
Nephropidae	<i>Homarus americanus</i>	American lobster	Homard américain	2550	<a href="#">156134</a>	1623	SF

## **2.4 Analyses**

The Oracle relational database where all data are stored was accessible from the Bedford Institute of Oceanography in Dartmouth, Nova Scotia. Structured Query Language (SQL) is used to extract the data from the production server and to create the data products used in all subsequent analyses. Catch records classified as "valid" (i.e. a representative tow without damage to the net) are used in the current analyses. To make the available samples comparable, catch number and weight for each species was standardized for the distance towed.

All data processing and analyses were conducted using the R software (R Core Team 2020) using packages gstat (Pebesma 2004), PBSmapping (Schnute et al. 2019), RODBC (Ripley and Lapsley 2019), spatstat (Baddeley 2015), maptools (Bivand and Lewin-Koh 2020), rgeos (Bivand and Rundel 2020), classInt(Bivand 2020), RColorBrewer(Neuwirth 2014), MASS (Ripley et al. 2020), worms (Holstein 2018), and tidyverse (Wickham 2019). The present document is rendered as a Technical Report using the csasdown R package developed and maintained by Fisheries and Oceans Canada scientists (Anderson et al. In press).

### **2.4.1 Geographic distribution of catches**

Spatial interpolation of catch biomass (kg/tow) or abundance (number/tow) was done using a weighting inversely proportional to the distance, using function "idw" of the spatstat R package (Baddeley 2015).

### **2.4.2 Abundance and biomass indices**

For each species, stratified random estimates of catch abundance and biomass (Smith 1996) were computed for each year. Yearly estimates of the standard error were also computed.

### **2.4.3 Distribution indices**

For each Category L, I and S fish species, the minimum area required to account for 75% and 95% of the total biomass or abundance were computed (D75% and D95%). These measures of distributions were computed for each year by using the Lorenz curve of mean stratum-level catch estimates and the area of occupied strata (Swain and Sinclair 1994; Swain and Morin 1996).

### **2.4.4 Length frequencies**

The length frequency distribution of catch is tabulated for each seven-year period (1970-2009), and last ten-year period (2010-2020).

#### **2.4.5 Length-weight relationship and condition factor**

The relationship between the weight and the length of fish was estimated using the following non-linear isometric relationship:

$$W = \alpha L^\beta$$

where W is the total weight (g), L is the length (cm), and,  $\alpha$  and  $\beta$  are the parameters to be estimated.

Average fish condition (C) was computed as:

$$C = \frac{W}{\alpha L^\beta}$$

#### **2.4.6 Depth, temperature and salinity distribution of catches**

For each category L species, We followed the methods developed by (Perry and Smith 1994) and generated cumulative frequency distributions of depth, temperature and salinity of survey catches.

#### **2.4.7 Density-dependent habitat selection**

We followed the methods of (Myers and Stokes 1989) to evaluate how fish abundance in each stratum varied with overall temporal fluctuations of population abundance.

For each category L species, we fitted a model of the relationship between stratum-level density and overall abundance (the yearly stratified random estimate of abundance, defined above). To properly use the observations of zero catch while accounting for the logarithmic distribution of catch abundance, we implemented the model as a generalised linear using a log link and a Poisson error distribution:

$$Y_{h,i} = \alpha_{h,i} Y_i^{\beta_{h,i}}$$

where,  $y_{h,i}$  is the average abundance of stratum  $h$  in year  $i$ , and  $\alpha_{h,i}$  and  $\beta_{h,i}$  are the fitted parameters. The estimated parameter  $\beta_{h,i}$  is referred to as the “slope parameter” and indicates whether stratum-level density is positively ( $\beta_{h,i} <= 0$ ), negatively ( $\beta_{h,i} >= 0$ ) or negligibly ( $\beta_{h,i} \approx 0$ ) related to population abundance.

To estimate the suitability of each stratum, the median abundance observed during the years that are in the top 25% of yearly estimates is used. We combine the slope parameter estimates from the above model with the median abundance to identify strata that have consistently high abundance and whose local density is weakly related to fluctuation in population abundance ( $\beta_{h,i} \approx 0$ ). Preferred strata are identified for each category L species.

### **3 Results**

The plots generated for each species are presented in the Appendix.

#### **3.1 Description of Figures**

##### **3.1.1 Type A**

For Category L and S species:

Spatial distribution of catch-per unit of effort, (CPUE, kilograms per tow) in July-August for the Bay of Fundy and Scotian Shelf in five-year periods. Spatial interpolation between tows was done using Inverse Distance Weight (IDW). The probability of occurrence (proportion of tows with catch records for a given species) was also reported for each five-year period.

For Category LR and SR:

Location of tows with catch over the period 1970-2012 (Type LR) or the period 1999-2012 (Type SR). Location of tows with catch over the period 1970-2012 (Type LR) or the period 1999-2012 (Type SR).

##### **3.1.2 Type B**

For Category L, S and I species:

Stratified random estimate of CPUE (left panel), distribution indices (D75% and D95%, the minimum area containing 75% and 95% of biomass, middle panel), and distribution vs. weight per tow (right panel). The stratified random mean is plotted as a solid line with the 95% confidence region indicated by the solid grey line. The overall mean is plotted as a grey horizontal line and the overall mean plus or minus 50% of the standard deviation appear as horizontal dashed lines. In all three panels, the early years appear in blue and the last years appear in red. The predictions from a loess estimator are overlaid on the distribution indices (middle panel). The Pearson correlation coefficient between D75% and biomass, and its statistical significance, are also reported in the right panel.

##### **3.1.3 Type C.**

Length frequency distribution for NAFO divisions 4X and 4VW. A smoothed length frequency distribution is shown for each 7-year periods covered by the surveys.

### **3.1.4 Type D.**

Average fish condition for all fish lengths (black dots and black line), large fish (thick gray line), and small fish (thin gray line). Fish condition is presented for NAFO divisions 4VW (right panel) and 4X (left panel).

### **3.1.5 Type E.**

Cumulative frequency distributions of depth, temperature and salinity at all sampled locations (thick solid line) and at fishing locations with catch records (thin dashed line). The depth, temperature and salinity associated with 5%, 25%, 50%, 75% and 95% of the cumulative catch is shown in tabular fashion on the bottom right panel.

### **3.1.6 Type F.**

Slopes estimates from the density-dependent habitat selection model (y axis) plotted versus the median abundance during the top 25% of years. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance. Each stratum is identified on the plot by the last two digits of its number.

## **3.2 Summary of successful tows by year and stratum**

There is something weird going on here, there are 2 tows with NAs for stratum, (HAM1980042 set 62 and HAM1982072 set 13).

Table 3. Number of representative tows conducted in each stratum during the period 1970 to 1991.

Stratum	NAFO Div.	Area (km <sup>2</sup> )	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
440	4VN	3173.016	4	2	2	3	3	3	3	3	3	3	3	3	3	3	3	4	5	5	5	6	4	4
441	4VN	3434.000	4	2	2	3	3	3	1	3	3	3	3	3	3	3	3	5	5	4	4	4	6	5
442	4VN	4934.658	3	2	2	2	3	3	2	3	3	3	3	3	3	3	3	3	5	6	7	5	5	5
443	4VSW	4526.012	4	2	4	4	8	3	1	2	4	4	4	3	5	4	4	4	6	6	5	2	4	2
444	4VSW	13478.450	3	2	5	4	6	4	6	7	4	4	4	5	5	6	4	4	6	6	3	6	7	8
445	4VSW	3512.982	5	2	5	4	5	5	1	3	4	4	4	5	5	3	4	5	6	4	4	4	4	4
446	4VSW	1686.094	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3	3	3	3
447	4VSW	5549.344	4	2	6	5	7	4	4	3	4	4	5	4	4	4	4	4	5	7	6	6	8	7
448	4VSW	4975.866	5	2	5	4	5	4	4	4	4	4	4	6	4	4	4	4	5	5	5	5	9	6
449	4VSW	494.496	2	2	2	2	3	2	2	2	1	2	2	2	1	2	2	2	2	2	2	2	2	2
450	4VSW	1315.222	2	2	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
451	4VSW	504.798	1	2	2	2	2	2	2	2	2	3	2	2	3	2	2	2	2	2	2	2	2	2
452	4VSW	1184.730	2	2	2	2	2	2	2	2	2	2	2	4	2	2	2	2	2	2	2	2	2	2
453	4VSW	889.406	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	3
454	4VSW	1713.566	3	2	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	2	2	3	2
455	4VSW	7286.948	7	6	7	6	7	6	6	7	7	7	7	7	7	7	7	7	8	8	7	7	12	10
456	4VSW	3279.470	5	4	6	5	5	6	4	6	6	6	7	6	6	6	6	6	7	6	6	10	7	7
457	4VSW	2784.974	2	2	2	2	3	2	2	2	2	2	2	3	2	2	2	2	2	4	2	2	4	2
458	4VSW	2259.572	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	5	5	3	3	8
459	4VSW	10810.232	3	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	6	6	5	6	5	5
460	4VSW	4615.296	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	4	3	3	3	3
461	4VSW	3962.836	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	2	2	1
462	4VSW	7266.344	3	3	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	6	5	4	4	5
463	4VSW	1037.068	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	3
464	4VSW	4453.898	4	3	5	3	3	6	5	5	5	5	5	5	5	4	5	5	7	6	5	5	9	7
465	4VSW	8183.222	6	5	5	4	5	4	5	5	5	5	5	5	7	6	5	5	5	8	8	8	12	9
466	4VSW	776.084	2	2	3	2	3	3	3	3	3	3	3	3	2	3	3	3	3	3	2	2	3	2
470	4X	3159.280	1	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	2
471	4X	3447.736	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
472	4X	4289.066	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4	4	4	6
473	4X	910.010	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2
474	4X	552.874	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
475	4X	535.704	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
476	4X	5075.452	2	2	2	2	2	2	3	2	2	2	1	2	2	2	2	2	2	2	4	4	4	4
477	4X	4230.688	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	5	4	4	5
478	4X	800.122	2	2	3	2	3	3	3	3	2	3	3	3	3	3	3	3	3	3	2	2	2	
480	4X	2249.270	4	4	4	4	3	3	3	4	4	3	4	3	3	4	4	4	4	4	4	4	8	
481	4X	6438.750	5	3	4	4	4	3	4	4	5	4	3	4	4	4	4	4	4	6	7	6	8	
482	4X	3578.228	2	1	2	2	2	2	2	3	2	2	3	2	2	2	2	2	2	2	3	3	3	
483	4X	1826.888	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
484	4X	7774.576	2	2	3	3	3	3	3	3	2	3	3	3	4	3	3	3	4	4	4	3	3	
485	4X	5432.588	2	2	2	3	3	3	3	3	3	3	3	3	4	3	3	3	3	6	7	6	2	
490	4X	2063.834	2	2	2	2	2	3	3	3	3	2	3	3	3	3	3	3	3	4	4	4	4	
491	4X	2359.158	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	
492	4X	3729.324	3	2	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	3	
493	4X	1830.322	1	2	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	
494	4X	1431.978	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
495	4X	2005.456	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	
171809.888		134	110	146	134	153	143	135	144	141	147	145	150	150	146	143	152	171	188	177	170	213	189	

Table 4. Number of representative tows conducted in each stratum during the period 1992 to 2013.

Stratum	NAFO Div.	Area (km <sup>2</sup> )	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
440	4VN	3173.016	4	3	4	4	4	4	4	4	6	4	4	4	4	4	4	4	3	4	4	5	4	4	
441	4VN	3434.000	5	5	5	5	5	5	6	7	6	6	7	6	7	6	6	5	6	6	7	6	6	6	
442	4VN	4934.658	6	5	6	6	6	6	7	6	6	5	6	7	5	5	5	5	5	6	5	6	6	6	
443	4VSW	4526.012	4	3	3	4	4	5	5	4	5	4	5	5	5	5	5	5	4	4	4	4	5	5	
444	4VSW	13478.450	8	9	6	8	8	7	8	8	9	10	9	9	9	8	10	8	6	9	11	13	9	8	
445	4VSW	3512.982	4	5	7	4	4	4	3	3	6	5	5	5	5	6	5	4	3	6	4	7	2	4	
446	4VSW	1686.094	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	4	3	3	
447	4VSW	5549.344	7	7	7	7	6	7	7	6	7	7	7	7	7	7	6	6	4	6	6	8	6	7	
448	4VSW	4975.866	6	7	7	7	6	7	6	7	8	8	8	8	7	8	8	6	5	7	7	10	8	8	
449	4VSW	494.496	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	4	2	2	
450	4VSW	1315.222	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
451	4VSW	504.798	2	2	2	2	4	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	
452	4VSW	1184.730	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
453	4VSW	889.406	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	1	2	2	1	3	2
454	4VSW	1713.566	2	2	2	2	2	3	2	2	2	2	2	2	2	3	2	2	2	2	2	4	2	2	
455	4VSW	7286.948	10	9	10	10	10	13	8	11	11	11	11	11	8	12	11	7	5	8	8	10	10	11	
456	4VSW	3279.470	7	8	8	8	8	8	8	6	8	10	8	8	8	8	8	6	2	7	7	9	8	8	
457	4VSW	2784.974	2	2	2	2	2	2	2	1	4	2	2	2	2	2	2	2	2	2	2	4	2	2	
458	4VSW	2259.572	8	8	8	8	7	8	5	6	10	8	7	8	8	10	8	5	2	7	6	9	8	6	
459	4VSW	10810.232	6	4	6	6	4	5	5	6	6	8	6	6	6	6	6	5	3	6	6	7	6	6	
460	4VSW	4615.296	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	2	3	3	4	4	3	
461	4VSW	3962.836	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4	2	2	2	2	3	3	2	
462	4VSW	7266.344	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	4	3	4	4	4	6	4	
463	4VSW	1037.068	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	3	2	2	
464	4VSW	4453.898	7	7	7	7	7	4	7	7	7	7	7	7	5	8	7	6	4	5	6	7	7	7	
465	4VSW	8183.222	10	10	10	10	10	10	9	10	10	10	10	10	10	10	10	7	8	7	8	10	10	10	
466	4VSW	776.084	2	2	2	3	2	2	3	2	2	2	2	2	2	2	2	2	1	3	2	2	2	2	
470	4X	3159.280	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	
471	4X	3447.736	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	
472	4X	4289.066	4	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	3	4	3	4	6	4	
473	4X	910.010	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
474	4X	552.874	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
475	4X	535.704	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
476	4X	5075.452	4	4	4	4	4	4	4	4	4	4	4	5	4	4	4	4	4	4	4	4	4	4	
477	4X	4230.688	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	
478	4X	800.122	2	2	2	3	3	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	
480	4X	2249.270	8	8	8	8	8	8	8	8	7	8	8	8	7	9	8	6	8	8	8	7	8		
481	4X	6438.750	9	9	9	9	7	9	9	9	8	9	8	9	9	6	12	9	7	8	8	8	10	9	
482	4X	3578.228	3	3	3	3	3	3	3	3	3	3	3	3	3	2	4	3	3	3	3	4	3	3	
483	4X	1826.888	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	
484	4X	7774.576	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	4	3	3	5	5		
485	4X	5432.588	3	3	3	3	3	3	3	3	4	3	5	5	3	2	5	4	5	5	5	6	5		
490	4X	2063.834	4	4	4	5	4	4	4	3	4	4	4	4	6	4	3	3	4	3	3	4	2		
491	4X	2359.158	3	3	3	3	3	3	3	3	3	3	3	3	5	3	3	4	3	4	4	4	4		
492	4X	3729.324	3	3	3	2	3	3	3	3	3	3	3	3	5	2	3	4	4	4	4	6	4		
493	4X	1830.322	3	3	3	3	2	3	3	2	3	3	4	5	2	4	4	3	3	4	3	4	4		
494	4X	1431.978	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	4	4	4		
495	4X	2005.456	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	5	3	3	4	3	4		
171809.888		193	190	195	195	191	193	186	191	213	201	208	216	188	222	209	177	165	196	196	243	210	208		

Table 5. Number of representative tows conducted in each stratum during the period 2014 to 2020 and for the whole 1970 to 2020 period.

Stratum	NAFO Div.	Area (km <sup>2</sup> )	2014	2015	2016	2017	2018	2019	2020	Total
440	4VN	3173.016	4	4	4	4	0	5	4	190
441	4VN	3434.000	6	6	6	6	0	7	4	238
442	4VN	4934.658	6	6	6	6	0	6	5	240
443	4VSW	4526.012	3	7	4	5	0	9	4	214
444	4VSW	13478.450	9	9	11	10	0	6	8	352
445	4VSW	3512.982	3	4	4	4	0	6	3	215
446	4VSW	1686.094	3	2	3	2	0	3	2	145
447	4VSW	5549.344	7	7	7	7	0	6	5	291
448	4VSW	4975.866	8	7	6	6	0	7	4	299
449	4VSW	494.496	2	2	2	2	0	2	2	100
450	4VSW	1315.222	3	3	3	2	0	3	2	144
451	4VSW	504.798	2	2	2	2	0	2	2	104
452	4VSW	1184.730	1	4	3	3	0	3	3	110
453	4VSW	889.406	3	2	2	1	0	2	2	116
454	4VSW	1713.566	2	2	2	2	0	3	2	121
455	4VSW	7286.948	11	9	9	8	0	9	6	429
456	4VSW	3279.470	6	5	6	6	0	6	4	331
457	4VSW	2784.974	2	3	3	3	0	3	2	113
458	4VSW	2259.572	4	5	5	5	0	6	3	269
459	4VSW	10810.232	6	7	7	6	0	9	7	262
460	4VSW	4615.296	3	5	5	5	3	6	5	151
461	4VSW	3962.836	2	3	3	3	2	3	3	113
462	4VSW	7266.344	5	5	5	5	0	5	5	212
463	4VSW	1037.068	2	3	2	2	0	2	2	107
464	4VSW	4453.898	7	6	6	4	0	6	4	288
465	4VSW	8183.222	10	10	9	7	3	10	7	397
466	4VSW	776.084	2	2	2	3	0	3	2	118
470	4X	3159.280	2	3	3	3	4	3	2	112
471	4X	3447.736	2	3	3	3	4	4	3	110
472	4X	4289.066	4	4	4	4	4	4	4	172
473	4X	910.010	2	2	2	2	2	2	2	104
474	4X	552.874	2	2	2	2	2	2	2	100
475	4X	535.704	2	2	2	2	2	2	2	103
476	4X	5075.452	4	5	5	5	5	5	5	177
477	4X	4230.688	6	5	5	4	4	6	4	204
478	4X	800.122	2	2	2	3	2	2	2	119
480	4X	2249.270	6	7	7	7	5	7	5	306
481	4X	6438.750	9	8	10	9	6	9	6	350
482	4X	3578.228	3	3	4	4	3	4	3	141
483	4X	1826.888	2	2	3	3	2	3	2	105
484	4X	7774.576	4	6	5	7	7	7	7	186
485	4X	5432.588	5	6	6	6	4	6	5	196
490	4X	2063.834	3	4	4	4	3	4	3	173
491	4X	2359.158	4	4	4	4	3	4	3	168
492	4X	3729.324	4	3	4	4	3	4	4	171
493	4X	1830.322	3	3	4	6	3	3	3	159
494	4X	1431.978	3	4	4	3	2	4	3	128
495	4X	2005.456	2	4	4	4	3	4	3	127
		171809.888	196	212	214	208	81	227	175	9080

A total of 9080 representative tows were conducted for the period spanning from 1970 to 2020.

#### **4 Discussion**

The current document is not meant to replace stock assessments, species-specific analyses of abundance, biomass and distribution, or any targeted attempts to integrate information about species or group of species from the wide and disparate sources of data about marine organisms in the area covered by the DFO Maritimes summer trawl survey. It is rather meant to provide a reproducible set of tools to extract and visualise the information collected in the DFO Maritimes summer trawl survey.

It is hoped that this document can provide a stepping stone to conduct other ecological analyses using the trawl survey data.

#### **5 Acknowledgements**

We thank all the dedicated personnel involved in running trawl surveys in the Maritimes Region.

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## 7 Appendix

## 7.1 Atlantic cod (*Morue franche*) - species code 10 (category LF)

Scientific name: [Gadus morhua](#)

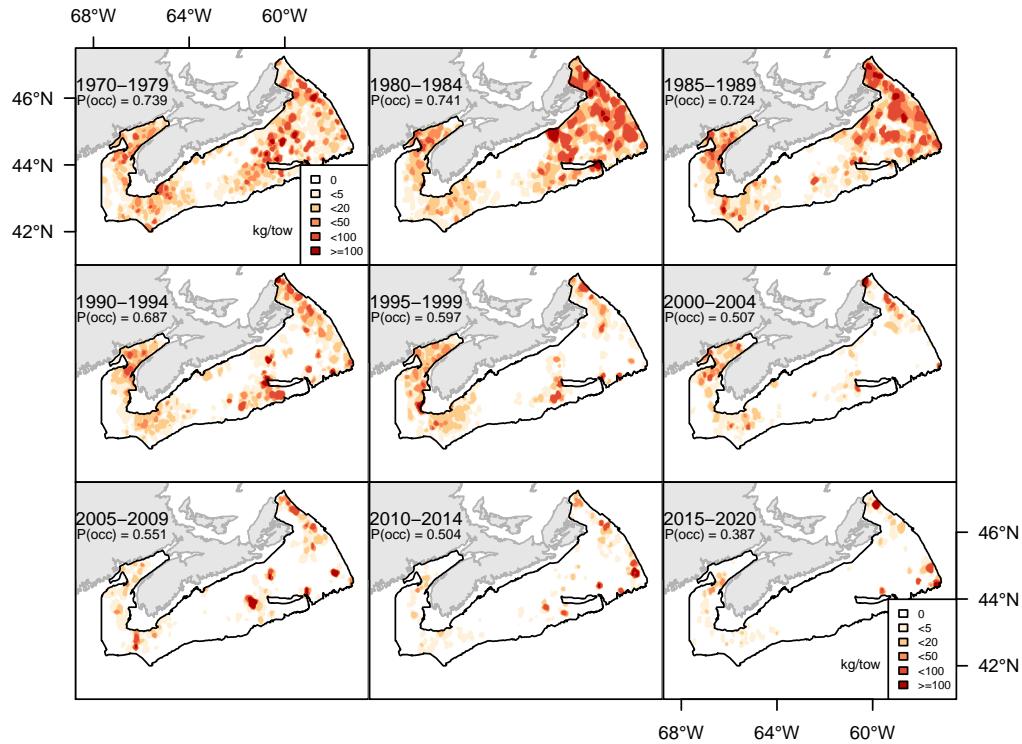


Figure 7.1A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic cod.

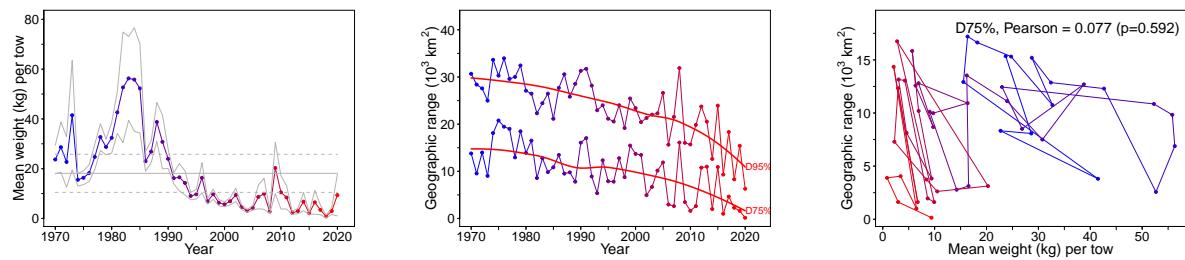


Figure 7.1B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic cod.

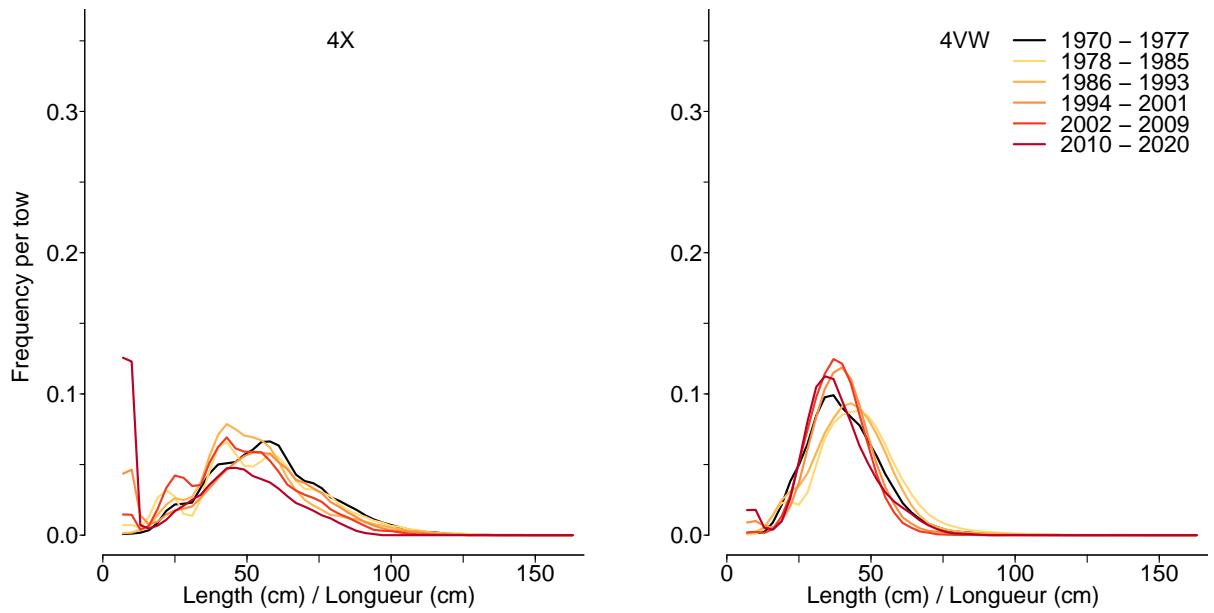


Figure 7.1C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic cod.

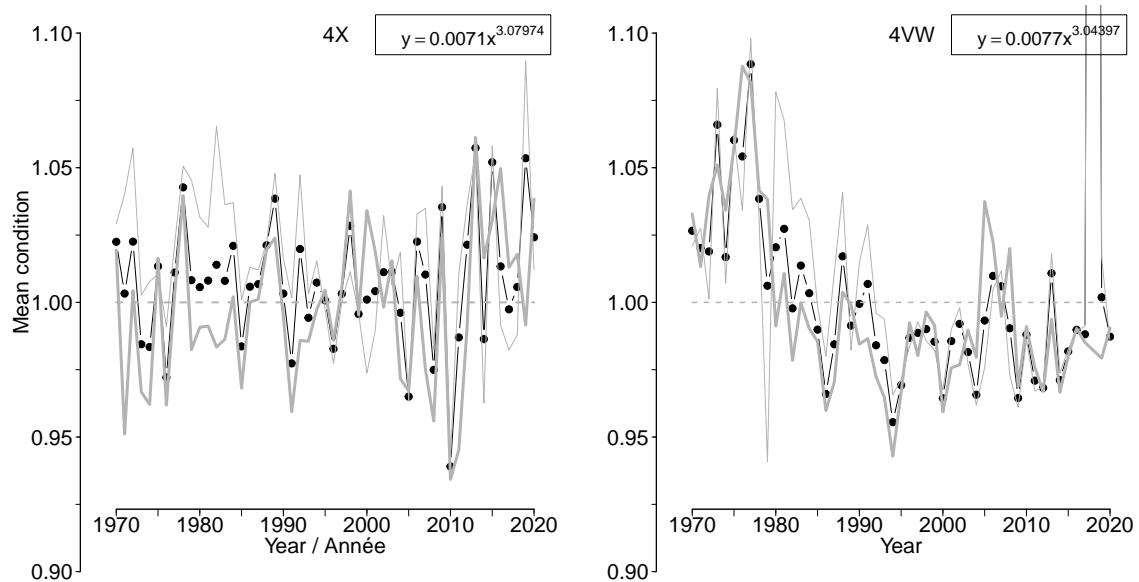


Figure 7.1D. Average fish condition in NAFO units 4X and 4VW for Atlantic cod.

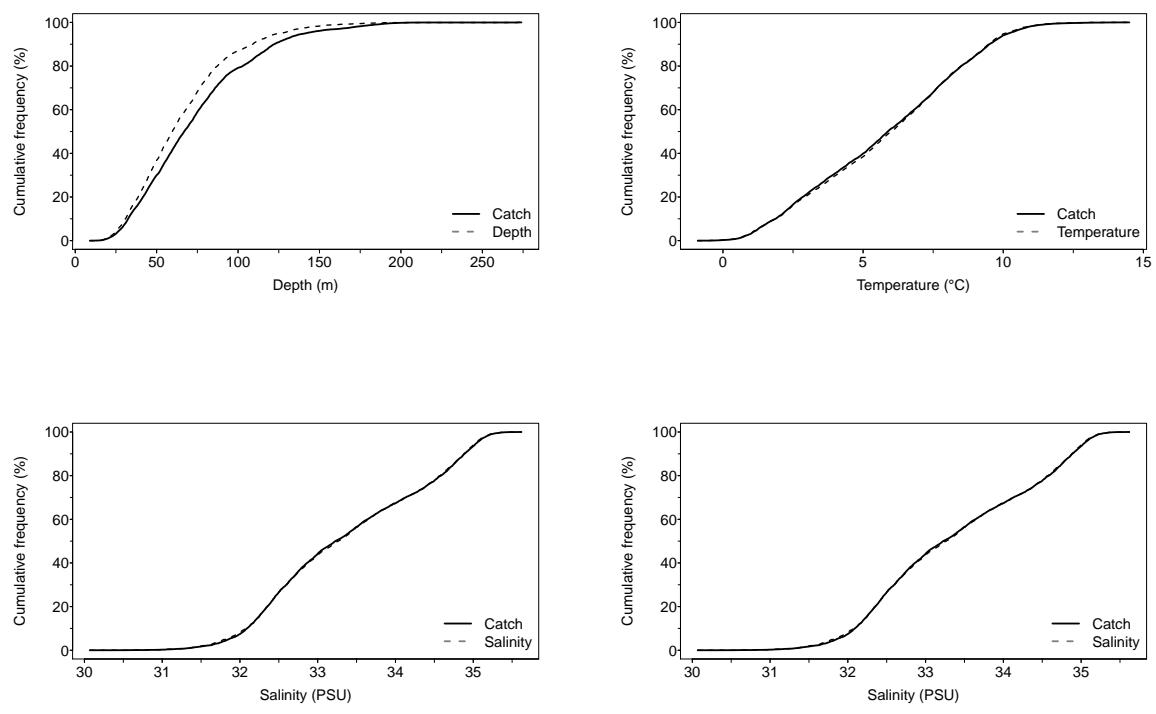


Figure 7.1E. Catch distribution by depth, temperature and salinity of Atlantic cod.

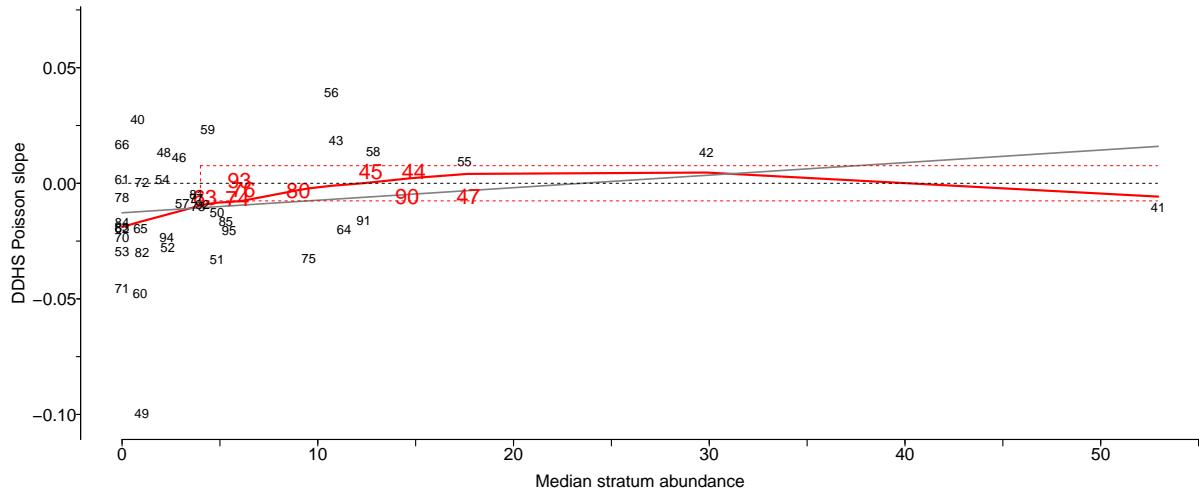


Figure 7.1F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Atlantic cod.

## 7.2 Haddock (Aiglefin) - species code 11 (category LF)

Scientific name: [Melanogrammus aeglefinus](#)

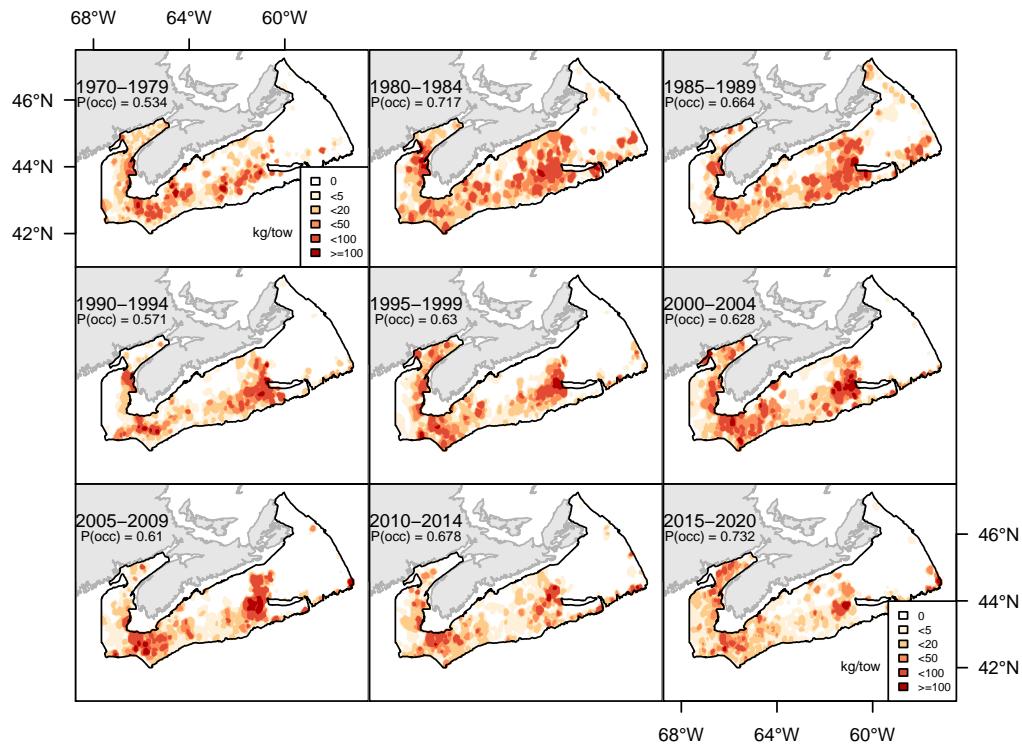


Figure 7.2A. Inverse distance weighted distribution of catch biomass (kg/tow) for Haddock.

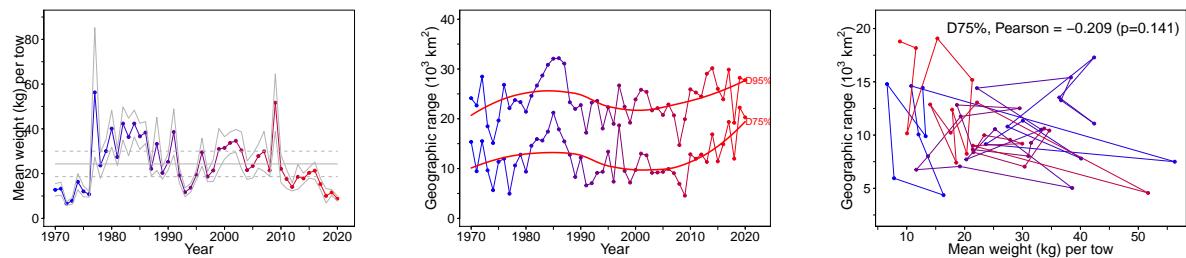


Figure 7.2B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Haddock.

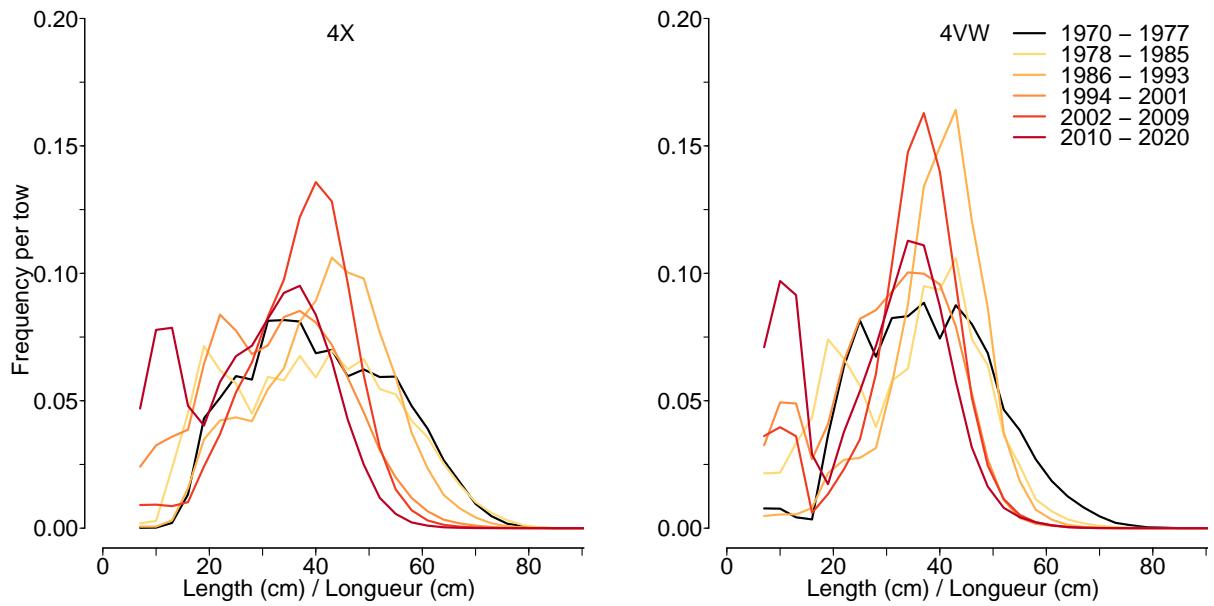


Figure 7.2C. Length frequency distribution in NAFO units 4X and 4VW for Haddock.

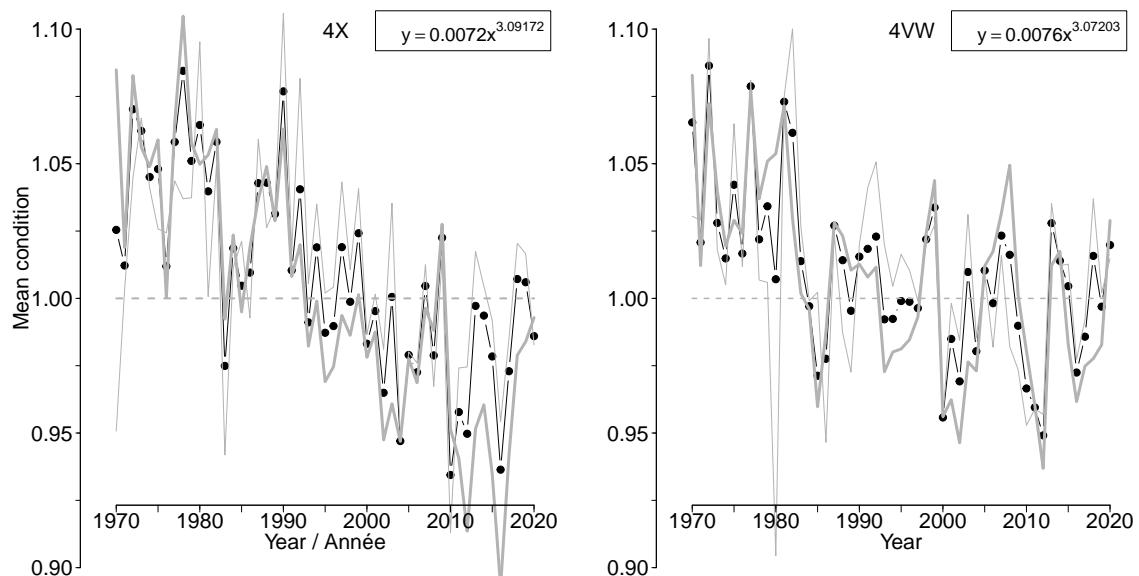


Figure 7.2D. Average fish condition in NAFO units 4X and 4VW for Haddock.

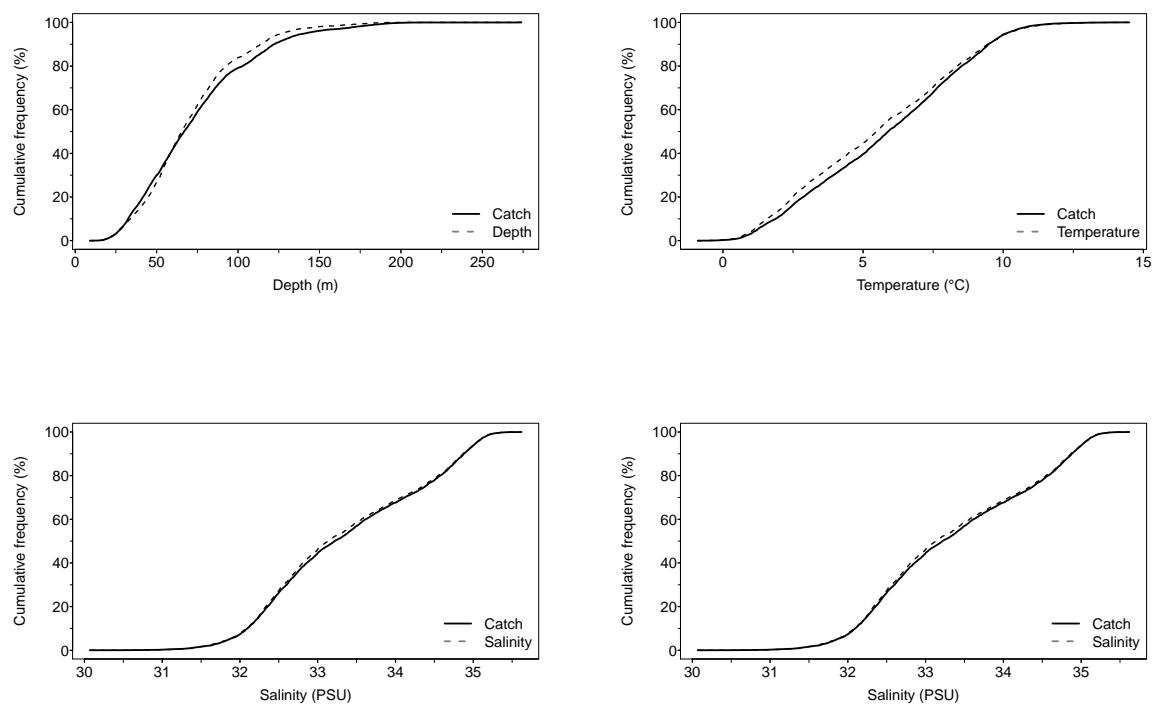


Figure 7.2E. Catch distribution by depth, temperature and salinity of Haddock.

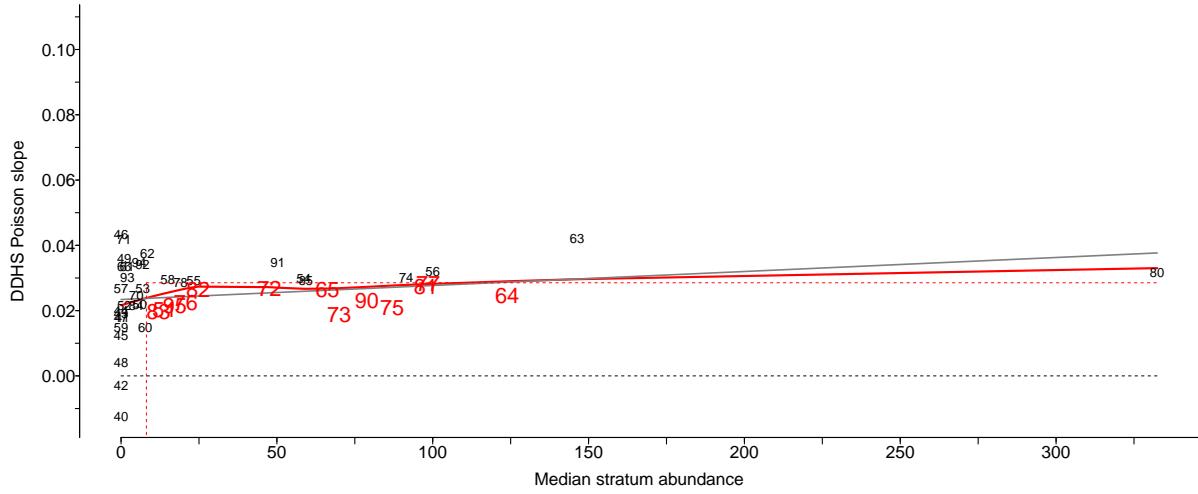


Figure 7.2F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Haddock.

### 7.3 White hake (Merluche blanche) - species code 12 (category LF)

Scientific name: [Urophycis tenuis](#)

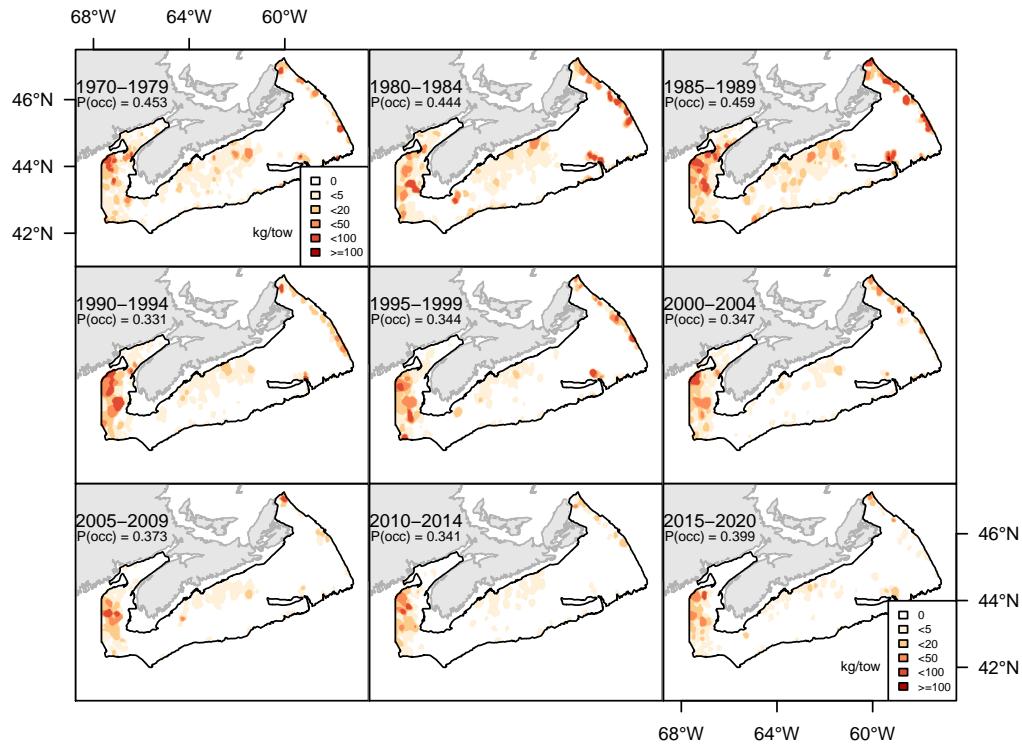


Figure 7.3A. Inverse distance weighted distribution of catch biomass (kg/tow) for White hake.

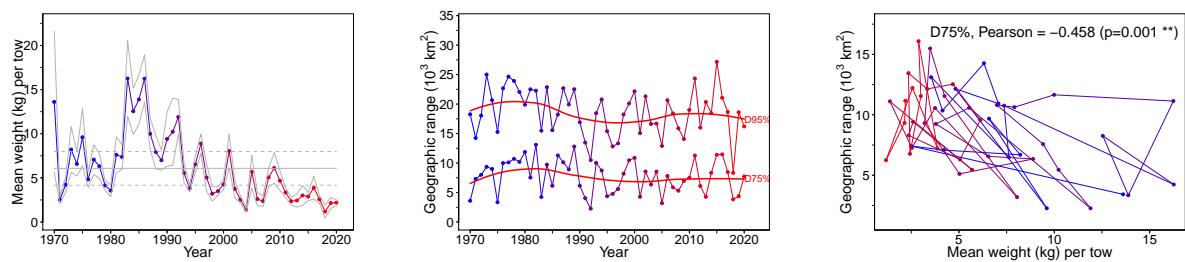


Figure 7.3B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of White hake.

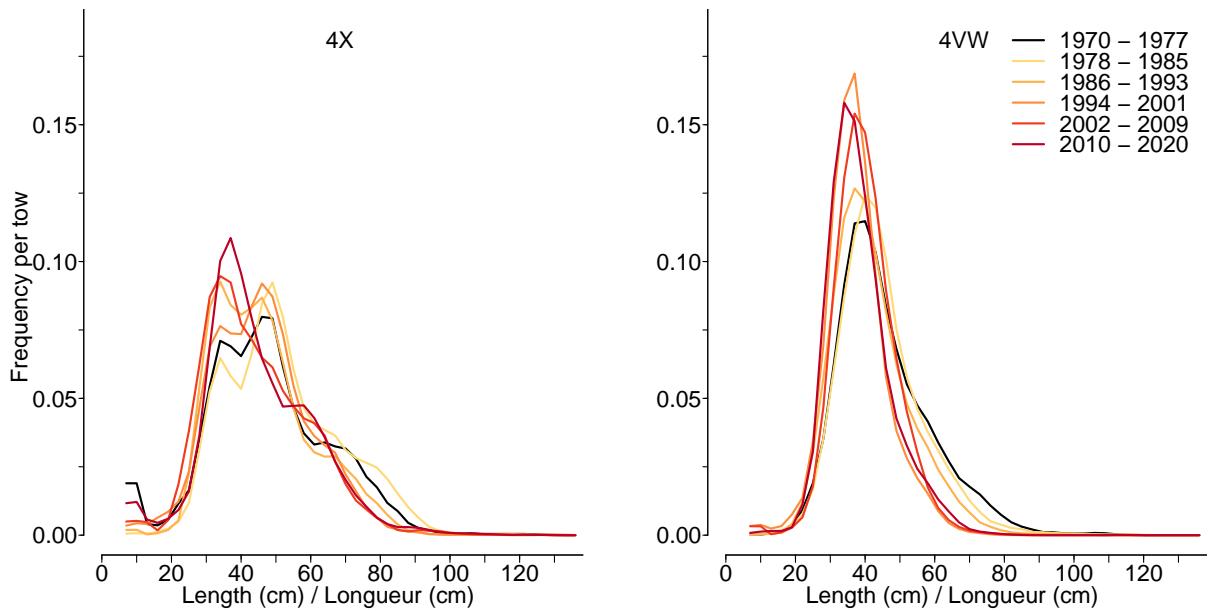


Figure 7.3C. Length frequency distribution in NAFO units 4X and 4VW for White hake.

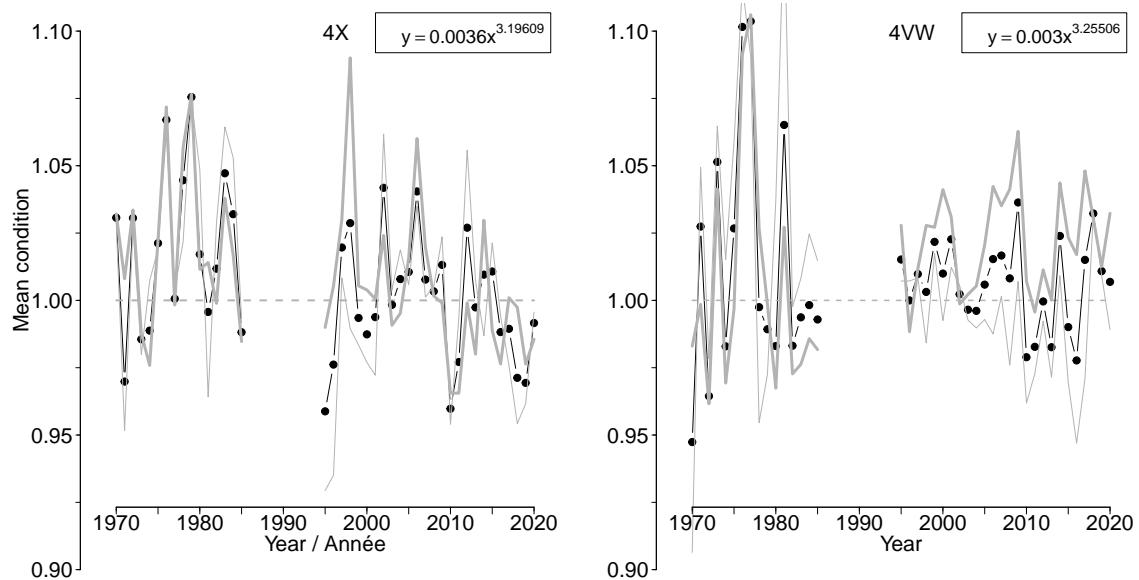


Figure 7.3D. Average fish condition in NAFO units 4X and 4VW for White hake.

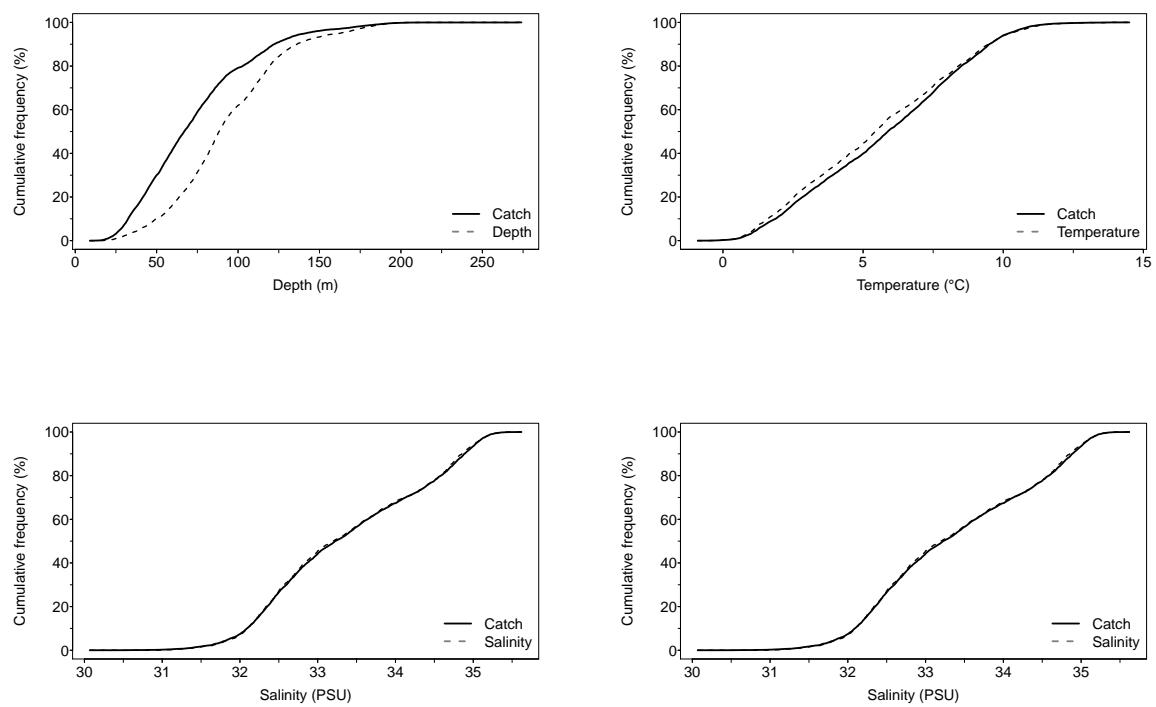


Figure 7.3E. Catch distribution by depth, temperature and salinity of White hake.

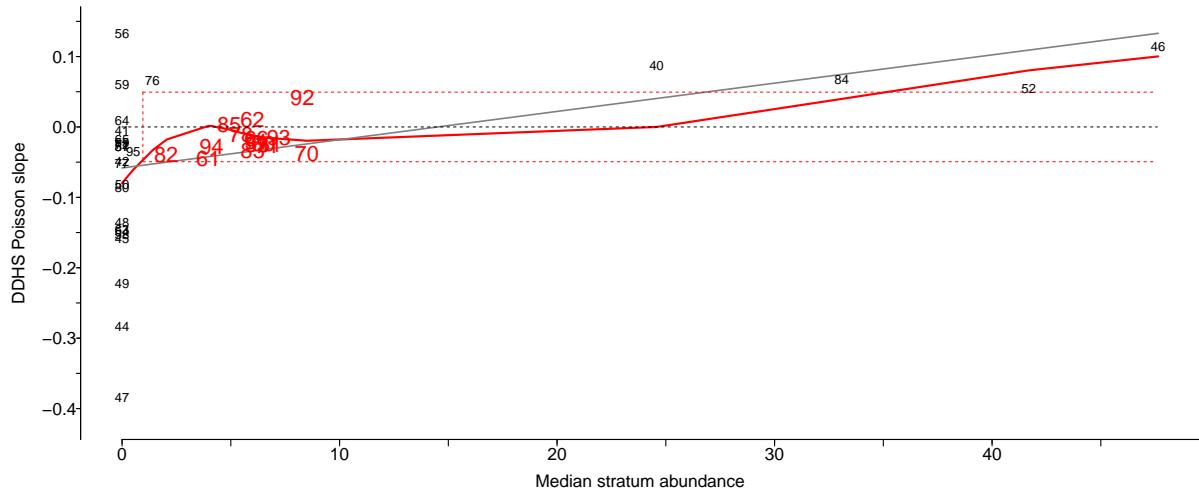


Figure 7.3F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for White hake.

## 7.4 Red hake (Merluche écureuil) - species code 13 (category LF)

Scientific name: [Urophycis chuss](#)

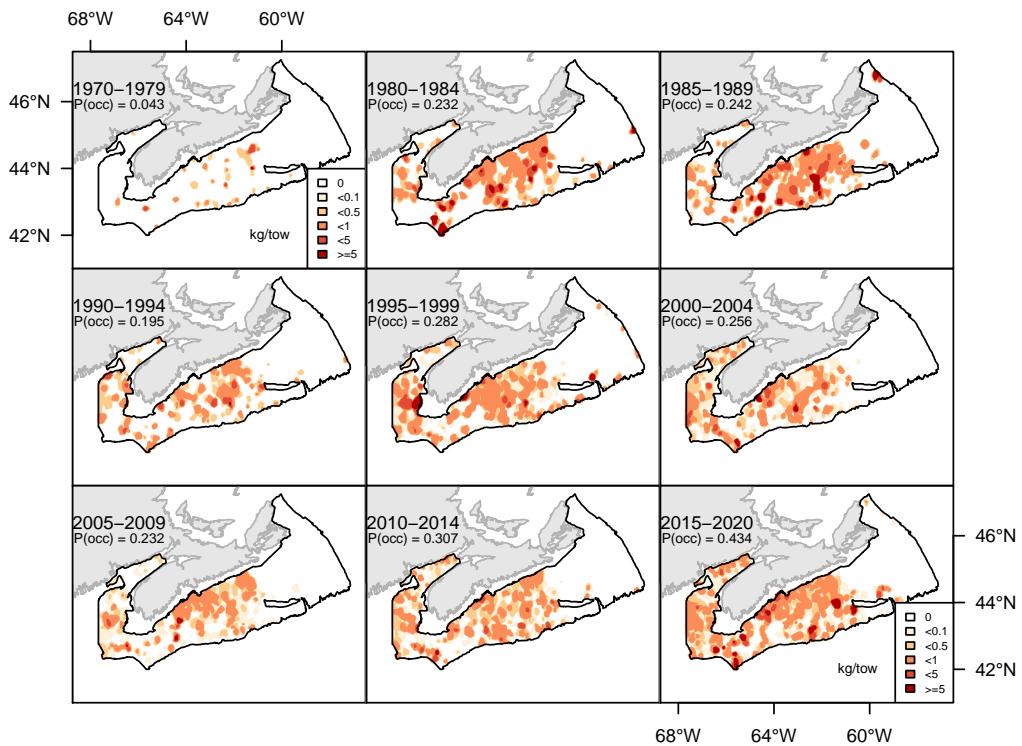


Figure 7.4A. Inverse distance weighted distribution of catch biomass (kg/tow) for Red hake.

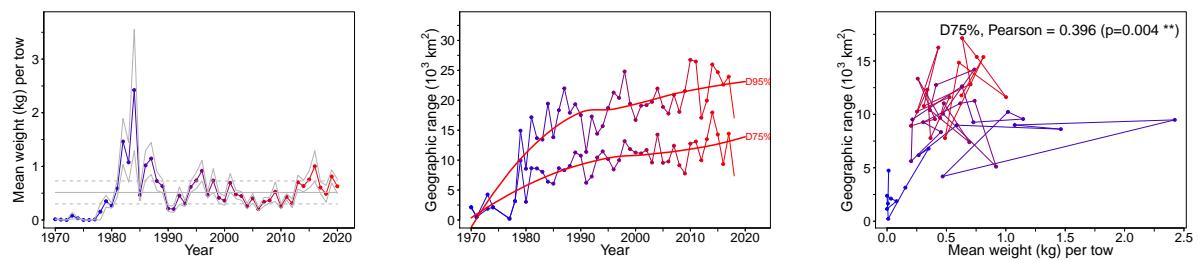


Figure 7.4B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Red hake.

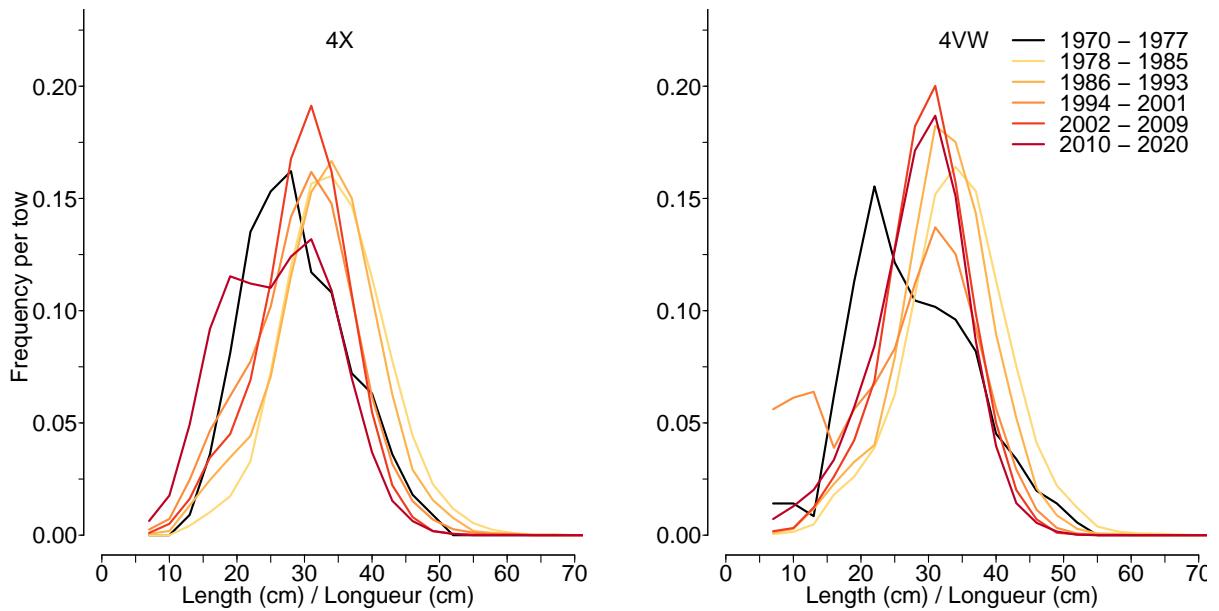


Figure 7.4C. Length frequency distribution in NAFO units 4X and 4VW for Red hake.

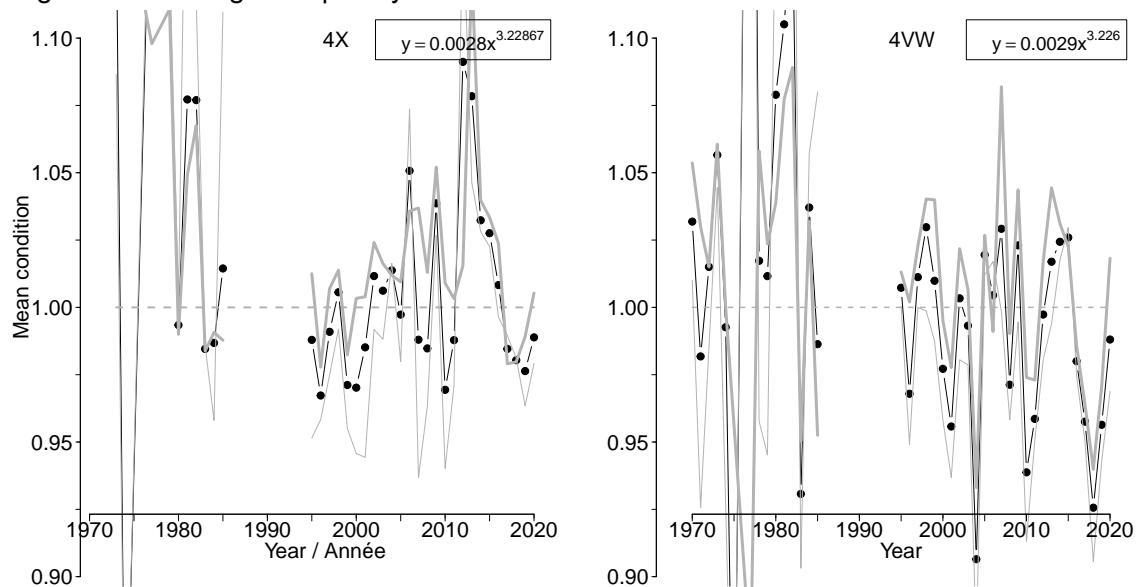


Figure 7.4D. Average fish condition in NAFO units 4X and 4VW for Red hake.

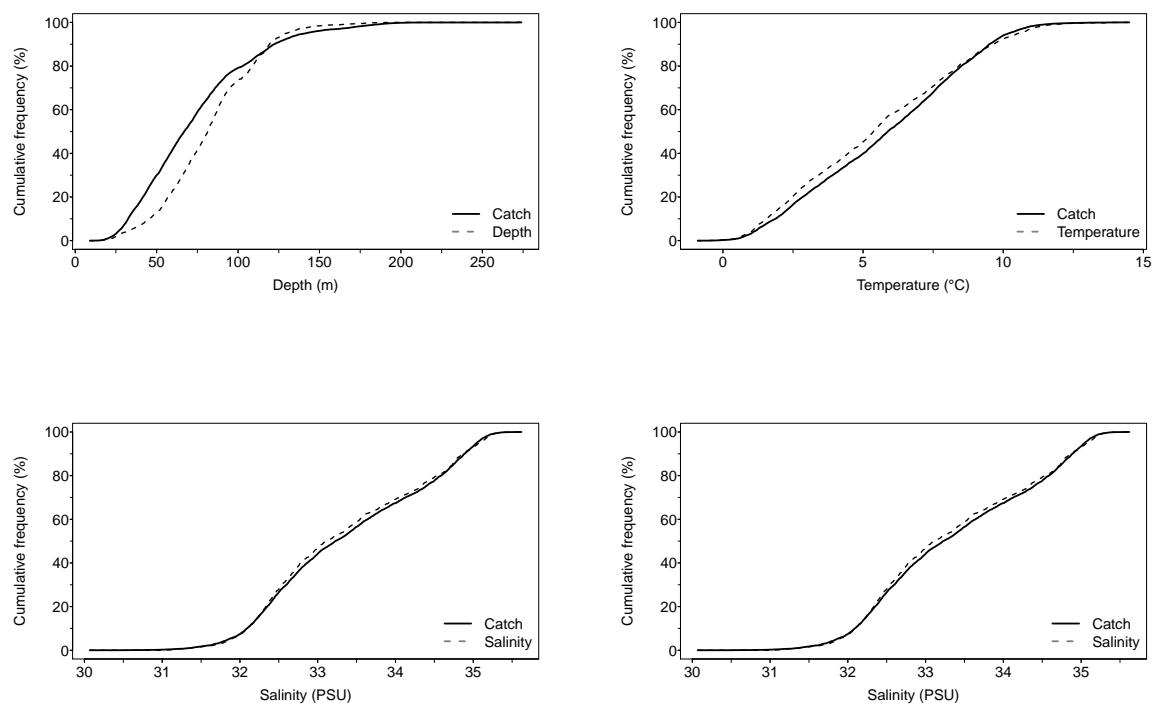


Figure 7.4E. Catch distribution by depth, temperature and salinity of Red hake.

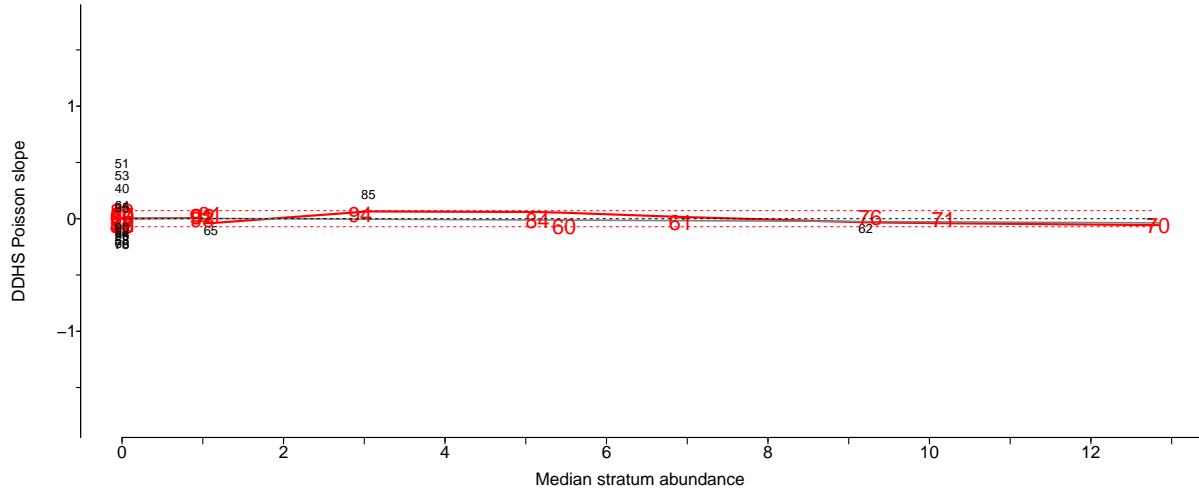


Figure 7.4F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Red hake.

## 7.5 Silver hake (Merlu argenté) - species code 14 (category LF)

Scientific name: [Merluccius bilinearis](#)

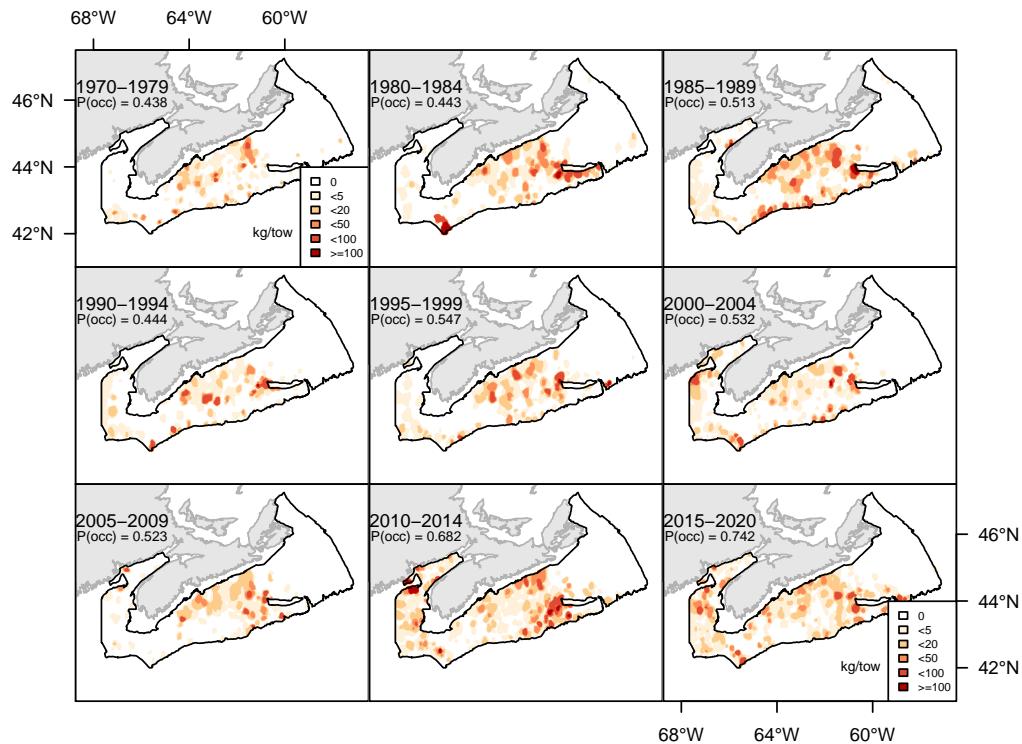


Figure 7.5A. Inverse distance weighted distribution of catch biomass (kg/tow) for Silver hake.

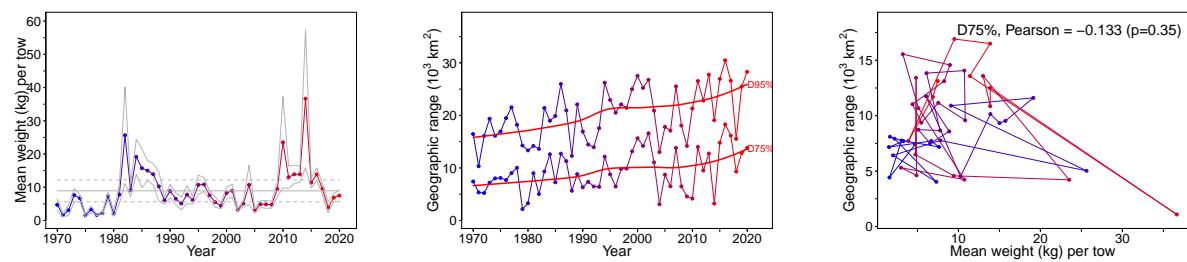


Figure 7.5B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Silver hake.

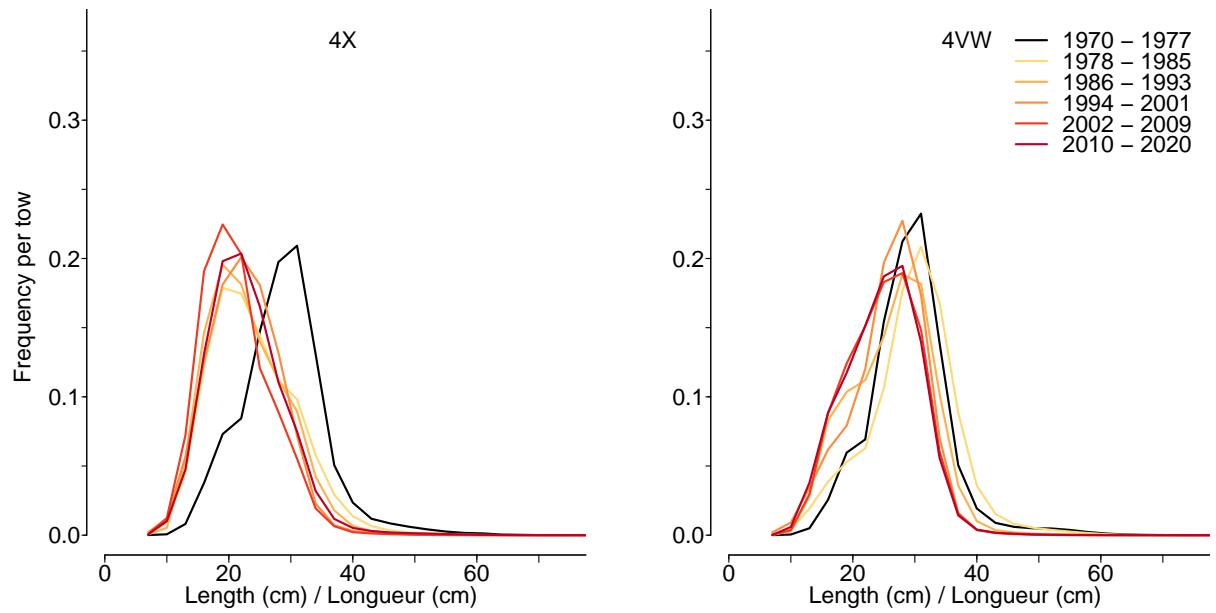


Figure 7.5C. Length frequency distribution in NAFO units 4X and 4VW for Silver hake.

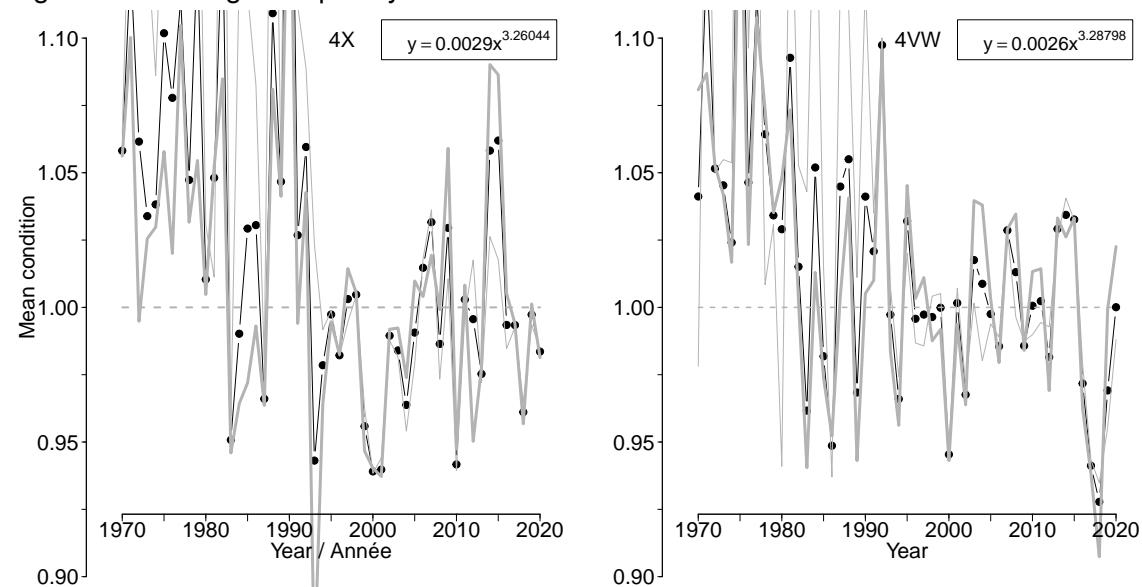


Figure 7.5D. Average fish condition in NAFO units 4X and 4VW for Silver hake.

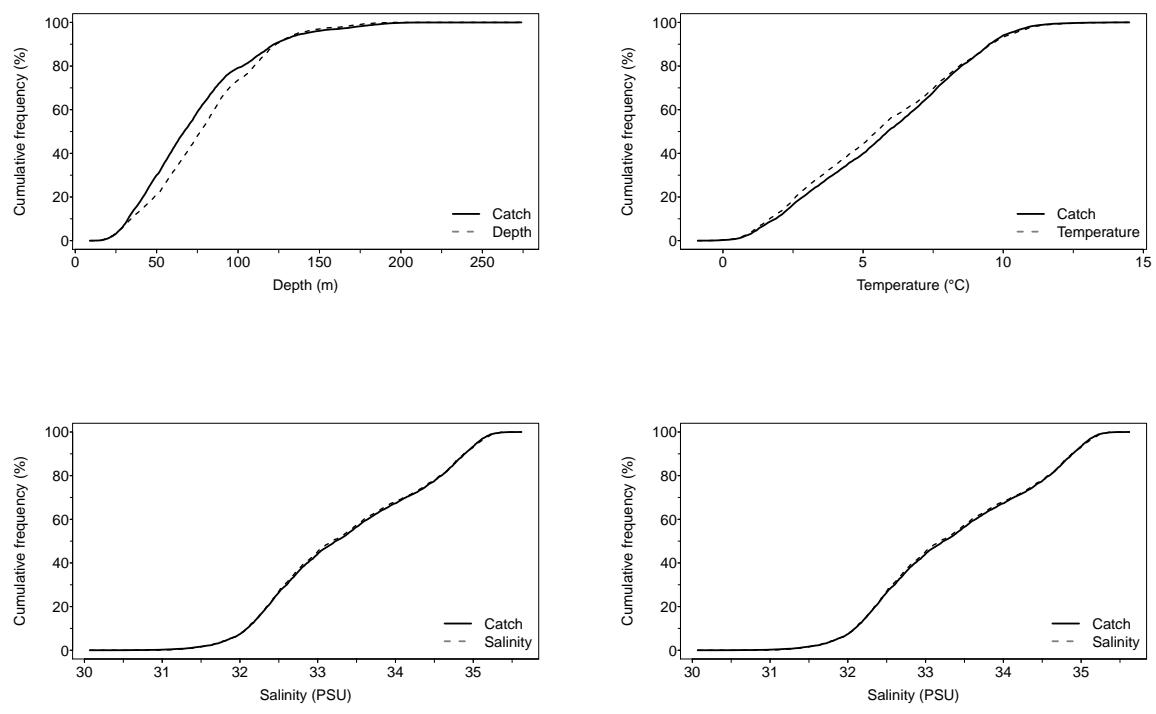


Figure 7.5E. Catch distribution by depth, temperature and salinity of Silver hake.

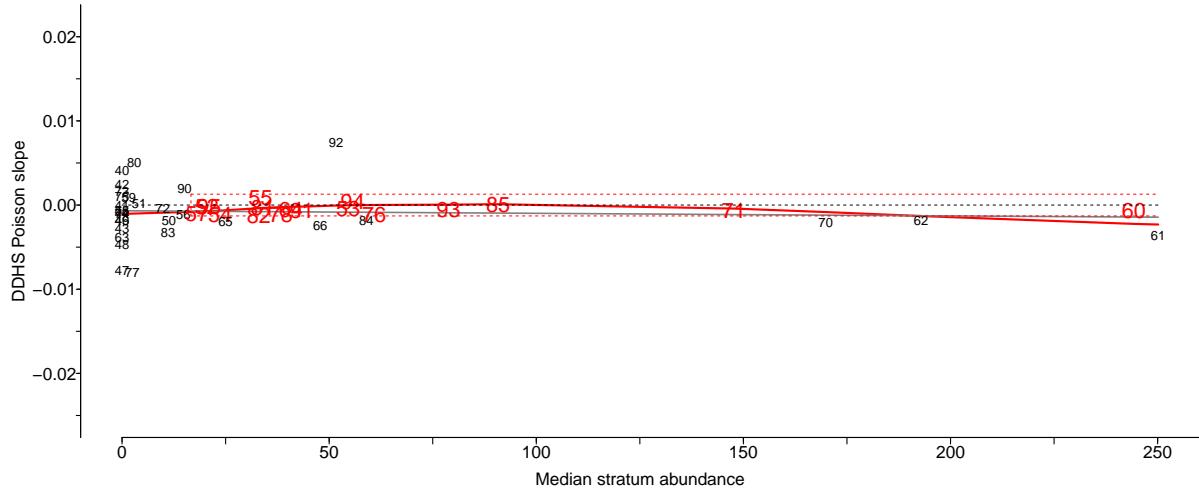


Figure 7.5F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Silver hake.

## 7.6 Pollock (Goberge) - species code 16 (category LF)

Scientific name: [Pollachius virens](#)

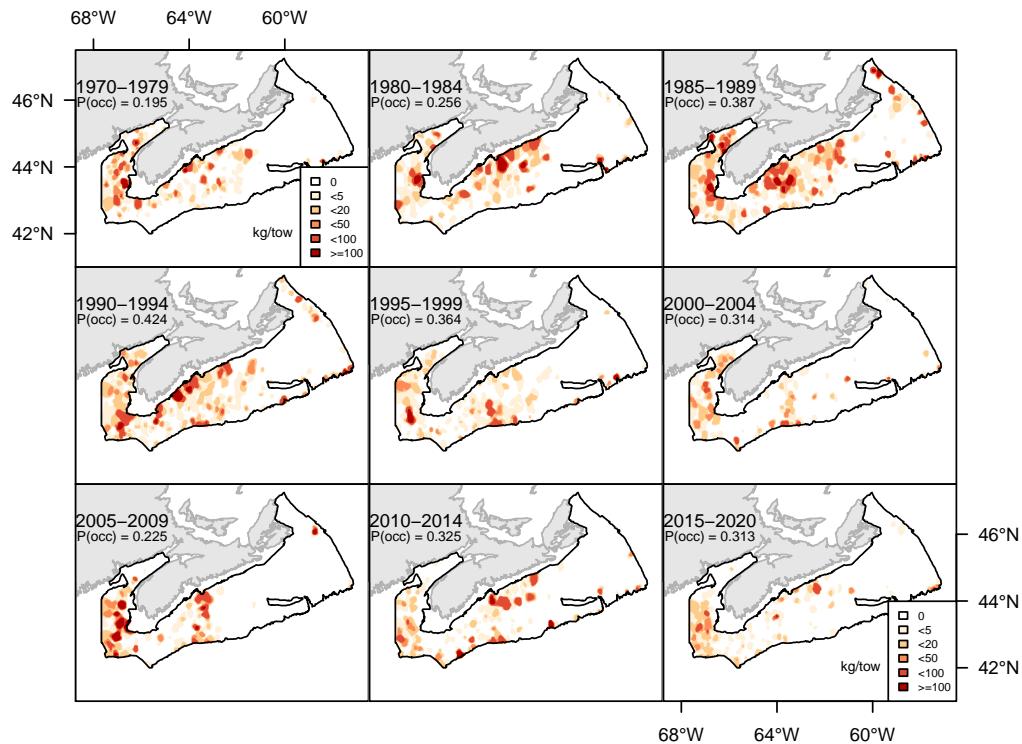


Figure 7.6A. Inverse distance weighted distribution of catch biomass (kg/tow) for Pollock.

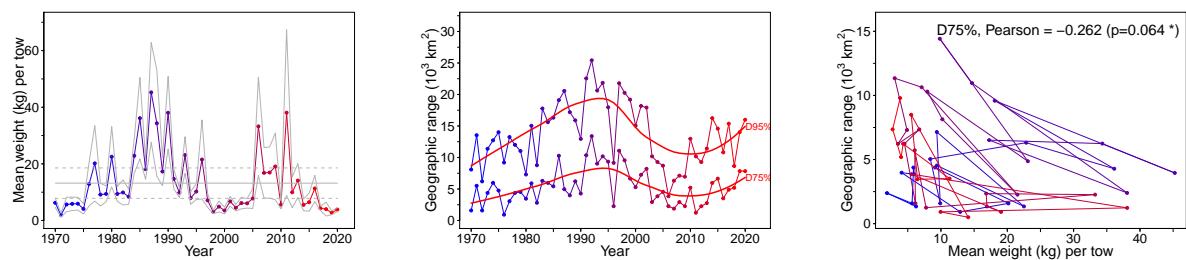


Figure 7.6B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Pollock.

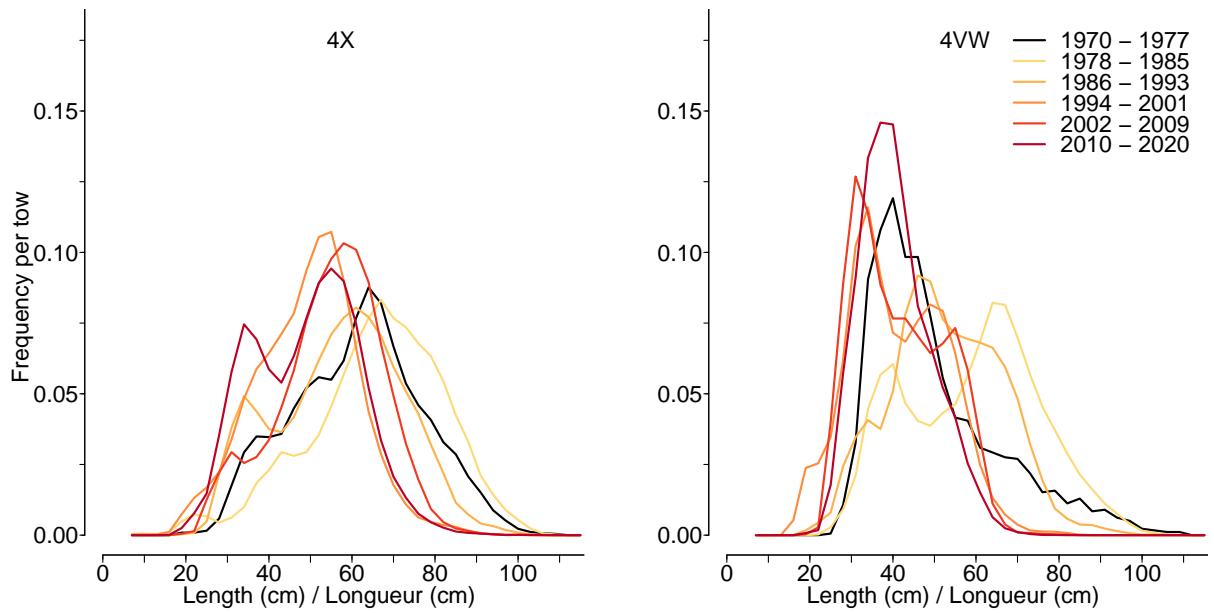


Figure 7.6C. Length frequency distribution in NAFO units 4X and 4VW for Pollock.

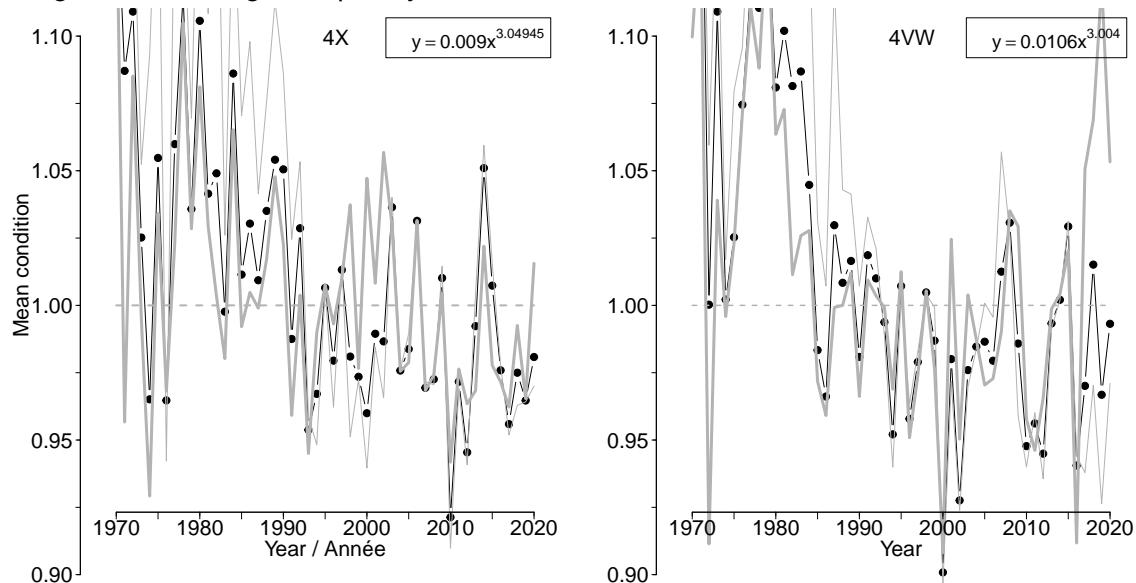


Figure 7.6D. Average fish condition in NAFO units 4X and 4VW for Pollock.

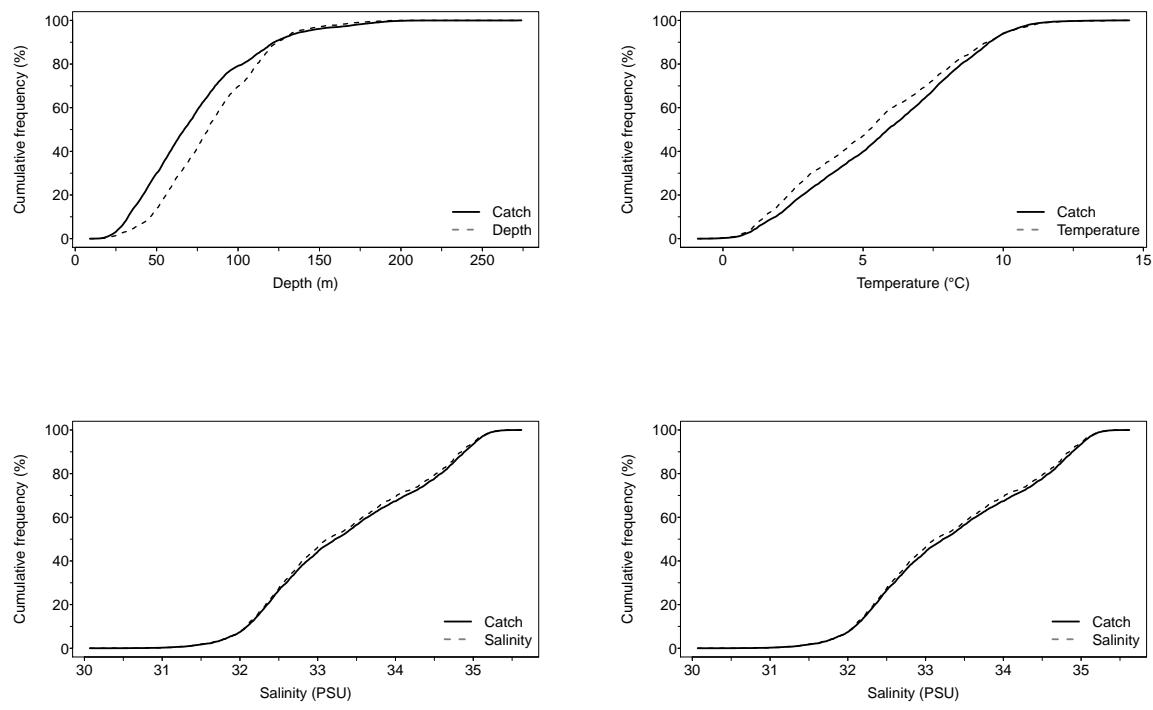


Figure 7.6E. Catch distribution by depth, temperature and salinity of Pollock.

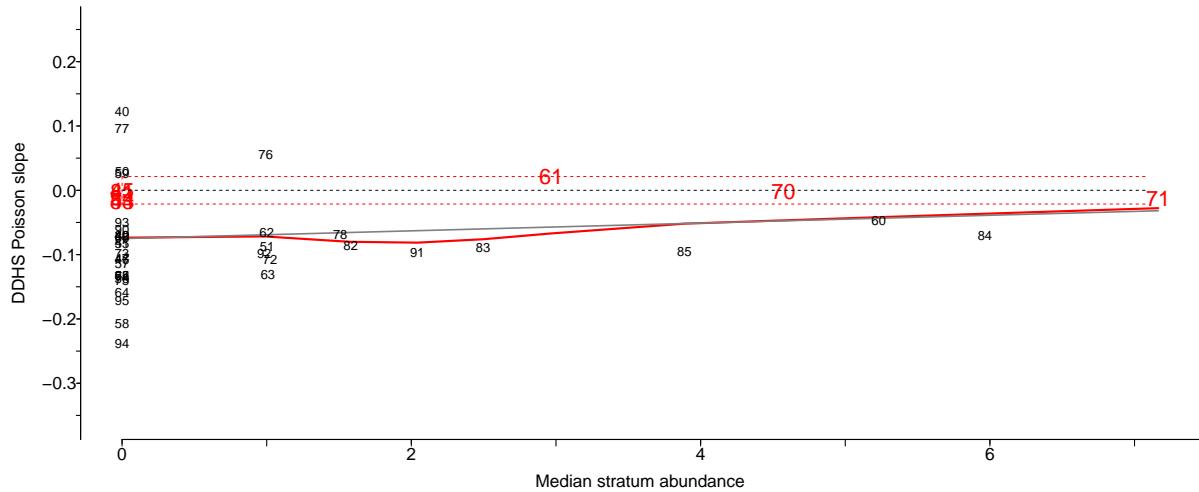


Figure 7.6F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Pollock.

## 7.7 Atlantic redfishes (Sébastes de l'Atlantique) - species code 23 (category LF)

Scientific name: [Sebastes](#)

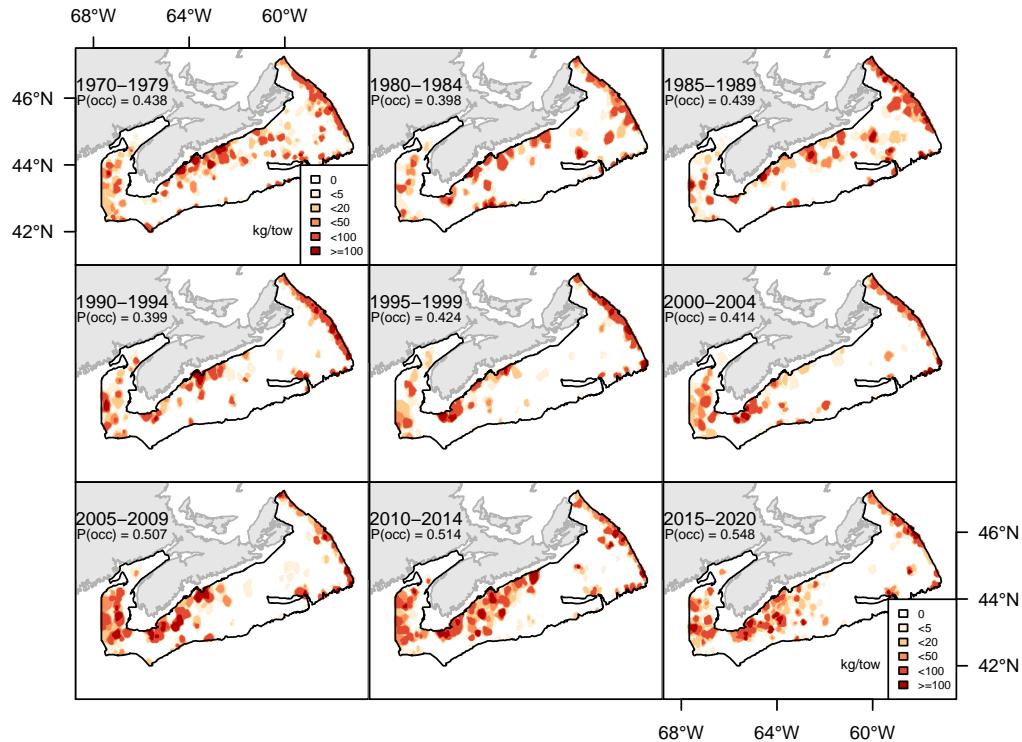


Figure 7.7A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic redfishes.

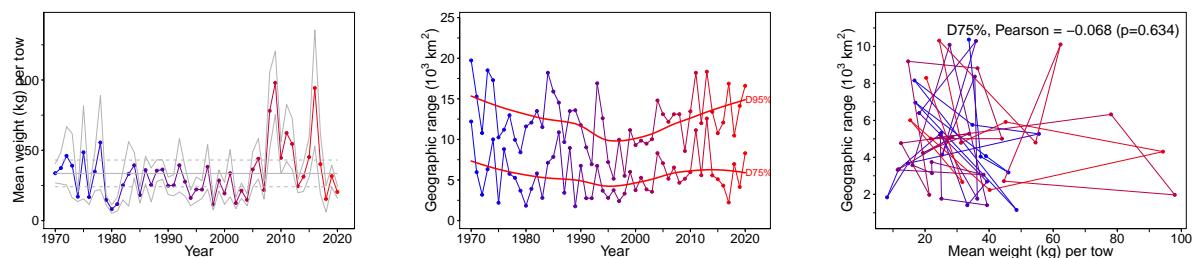


Figure 7.7B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic redfishes.

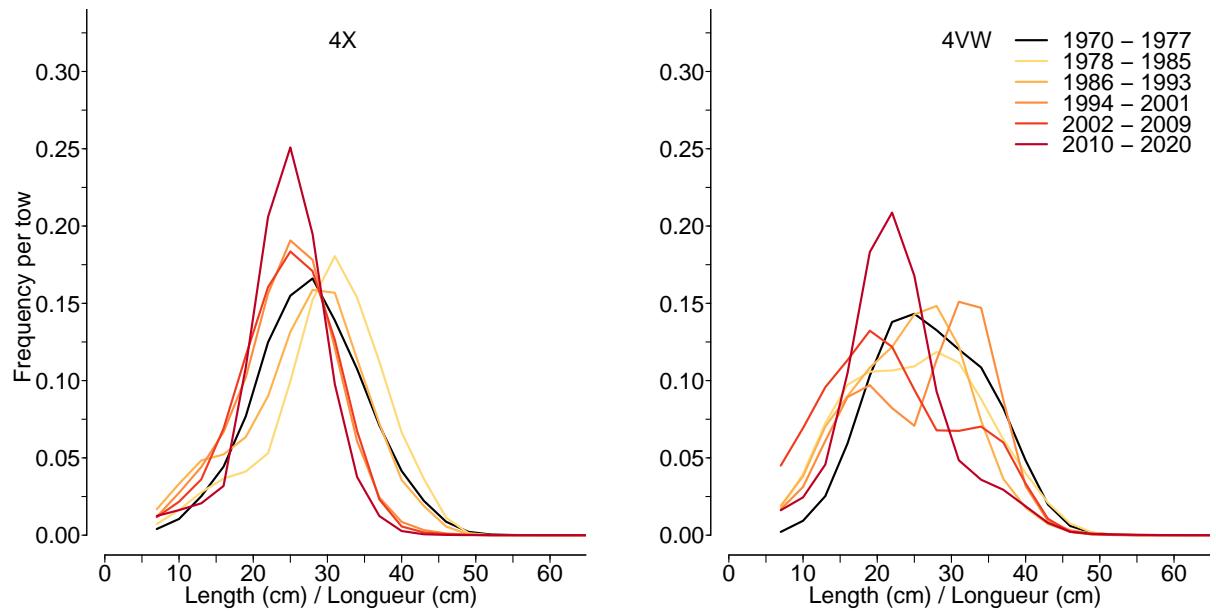


Figure 7.7C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic redfishes.

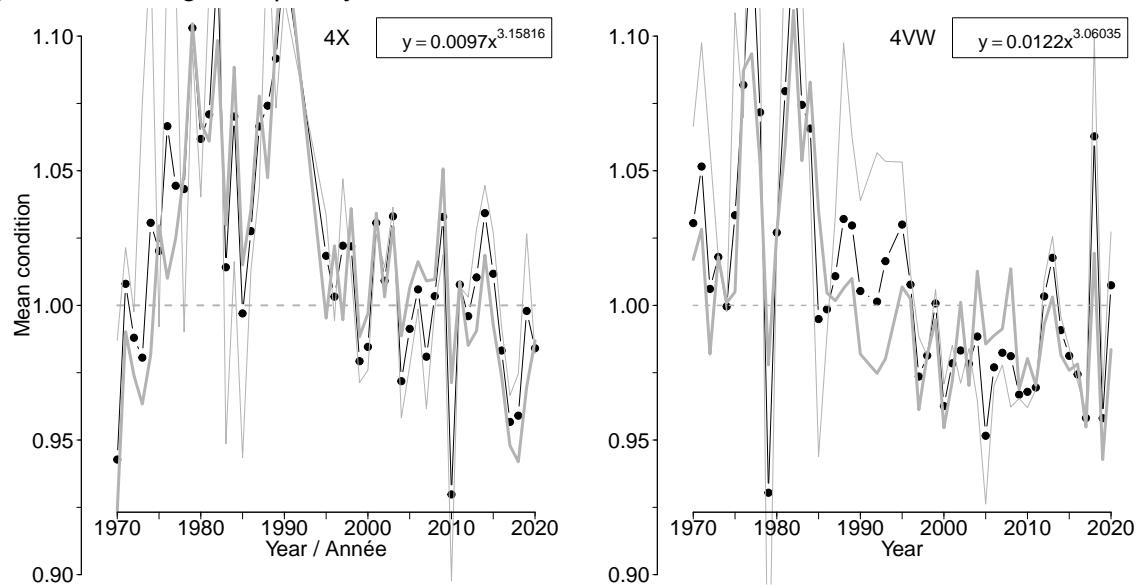


Figure 7.7D. Average fish condition in NAFO units 4X and 4VW for Atlantic redfishes.

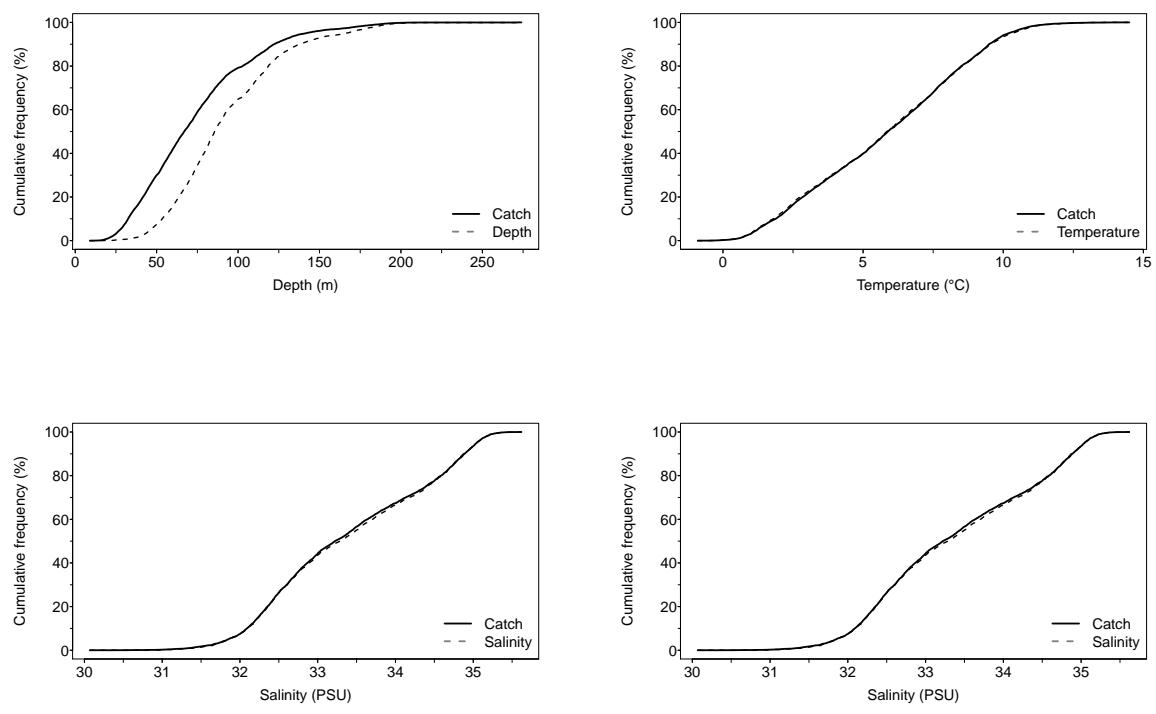


Figure 7.7E. Catch distribution by depth, temperature and salinity of Atlantic redfishes.

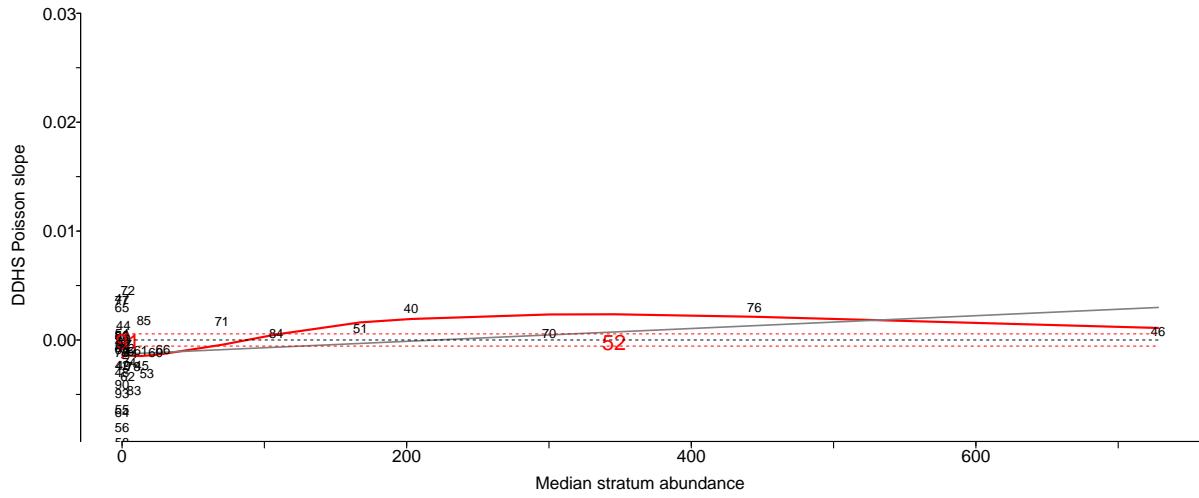


Figure 7.7F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Atlantic redfishes.

## 7.8 Atlantic halibut (Flétan de l'Atlantique) - species code 30 (category LF)

Scientific name: [Hippoglossus hippoglossus](#)

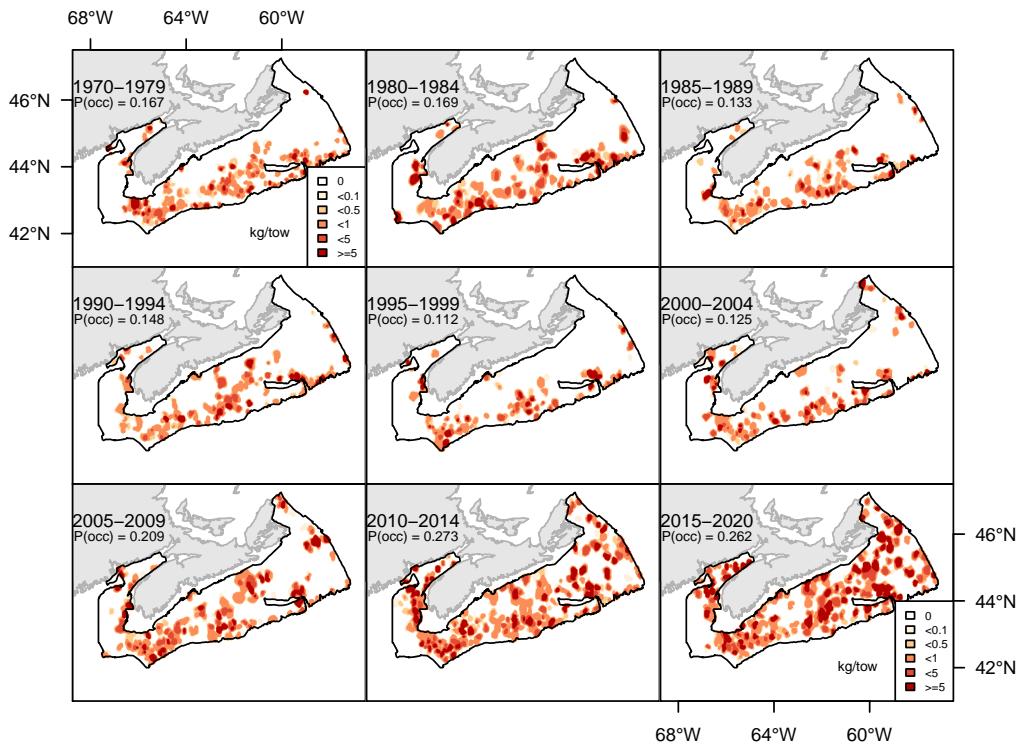


Figure 7.8A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic halibut.

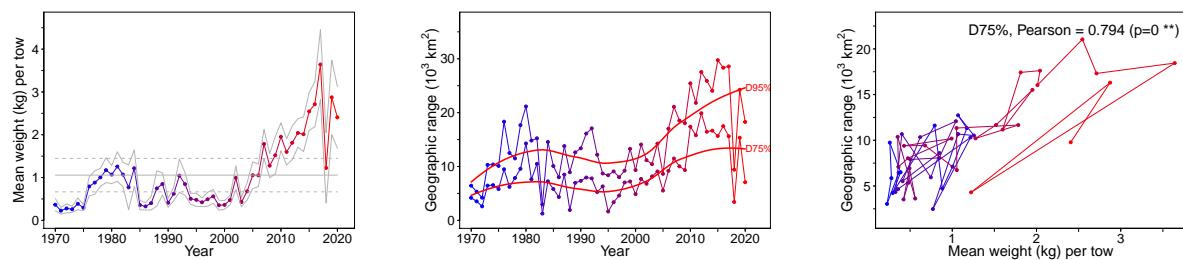


Figure 7.8B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic halibut.

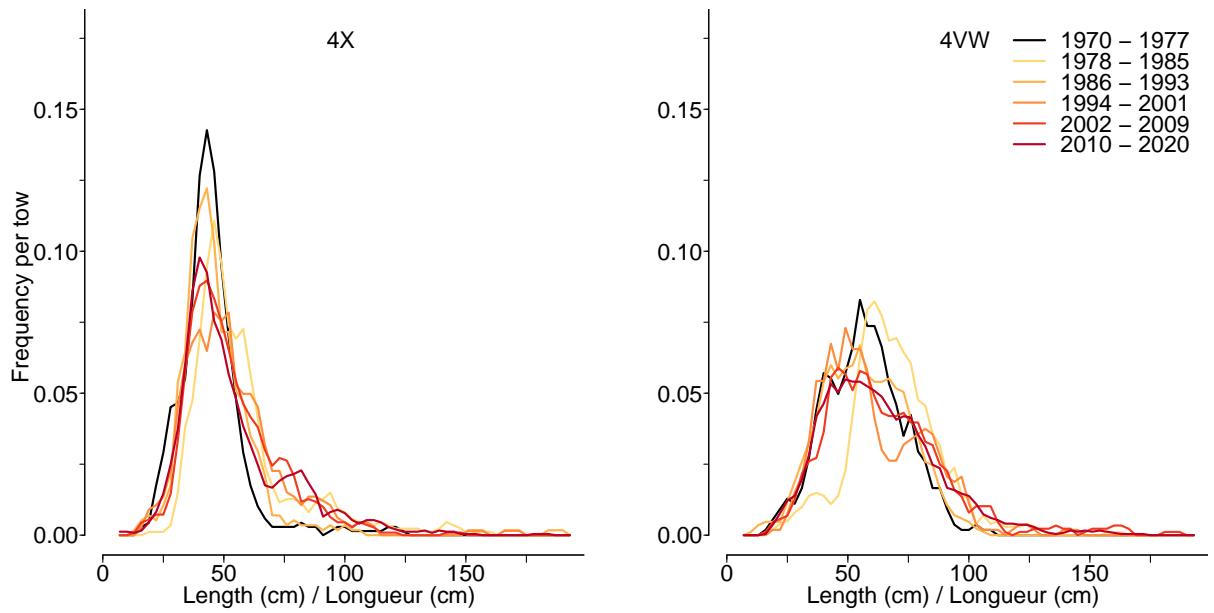


Figure 7.8C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic halibut.

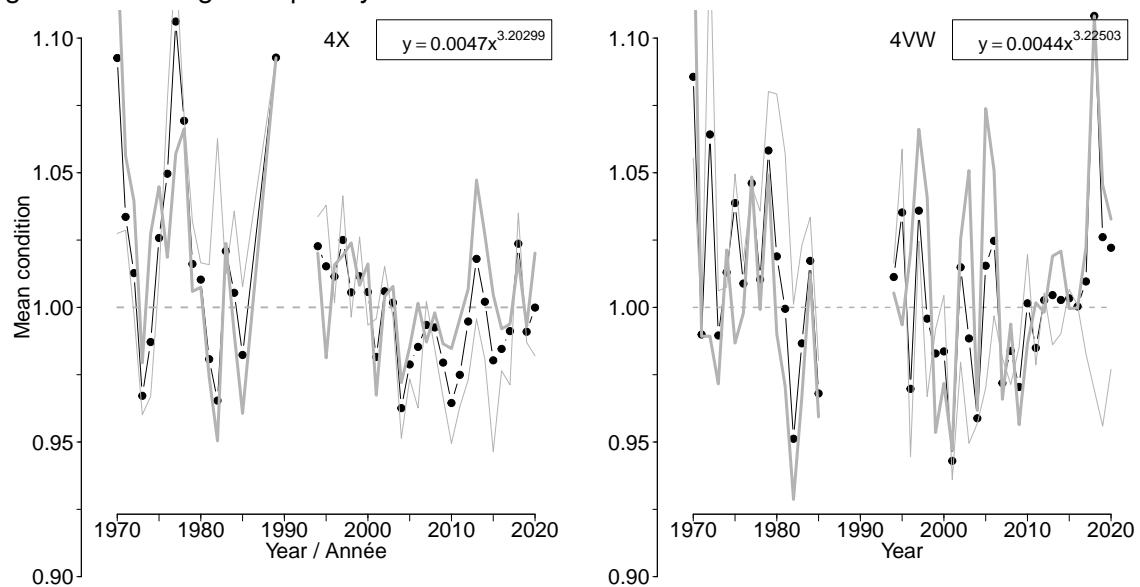


Figure 7.8D. Average fish condition in NAFO units 4X and 4VW for Atlantic halibut.

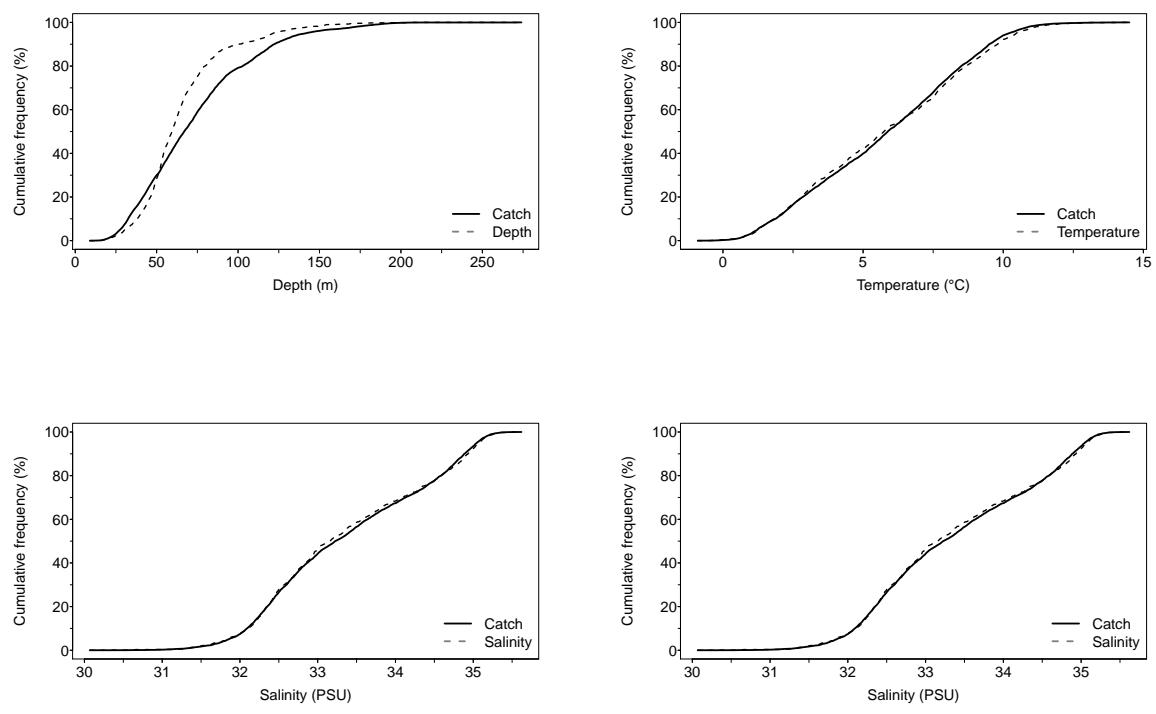


Figure 7.8E. Catch distribution by depth, temperature and salinity of Atlantic halibut.

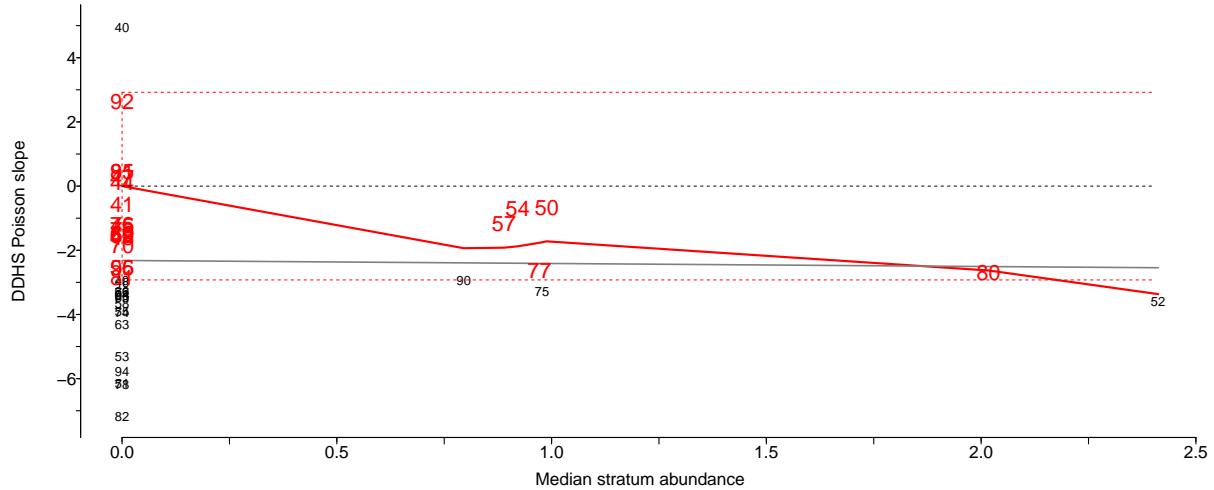


Figure 7.8F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Atlantic halibut.

## 7.9 American plaice (*Ple canadienne*) - species code 40 (category LF)

Scientific name: [Hippoglossoides platessoides](#)

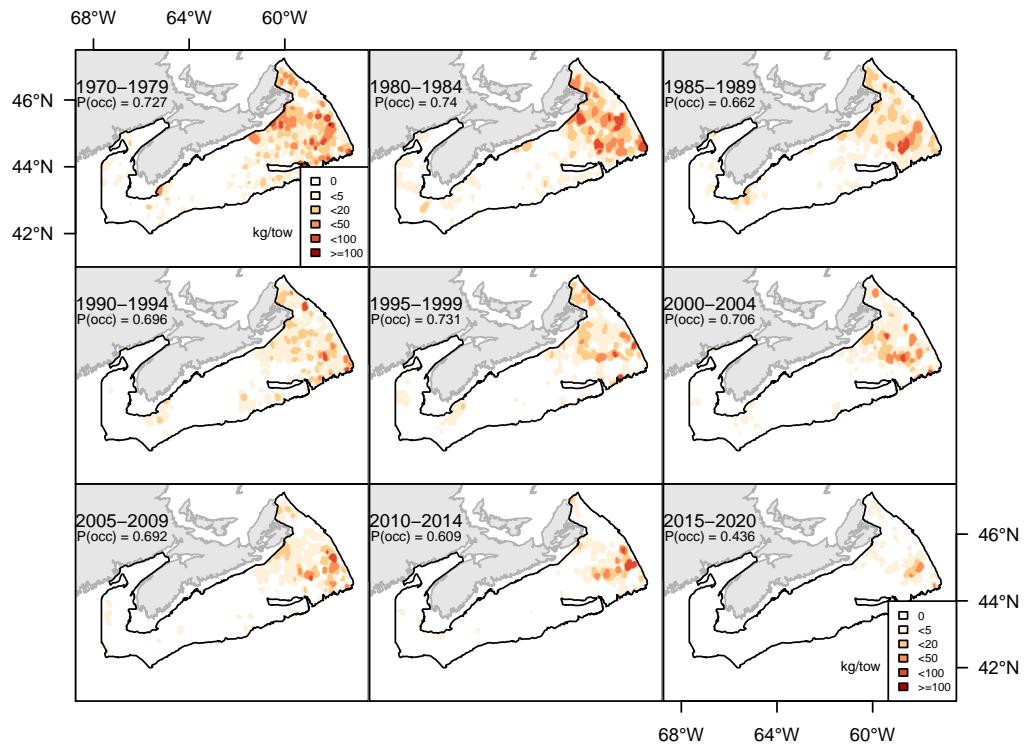


Figure 7.9A. Inverse distance weighted distribution of catch biomass (kg/tow) for American plaice.

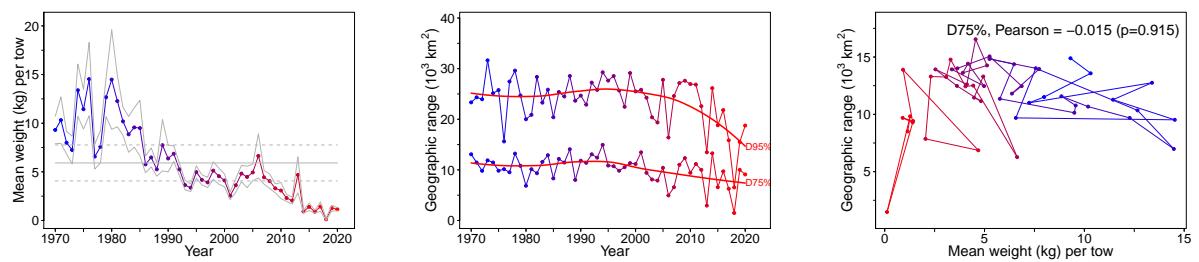


Figure 7.9B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of American plaice.

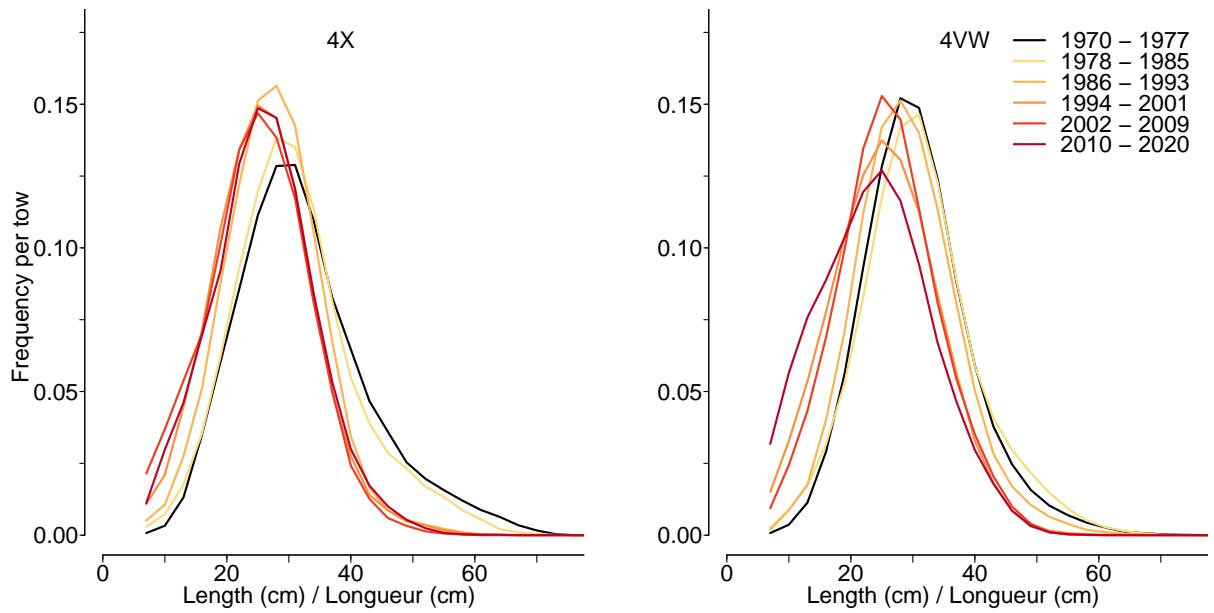


Figure 7.9C. Length frequency distribution in NAFO units 4X and 4VW for American plaice.

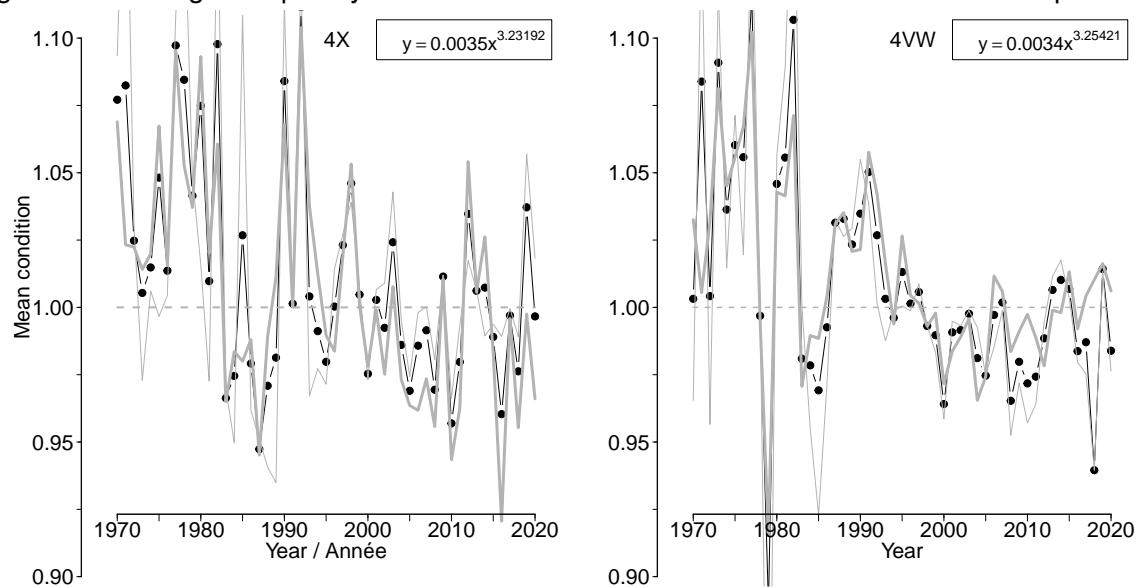


Figure 7.9D. Average fish condition in NAFO units 4X and 4VW for American plaice.

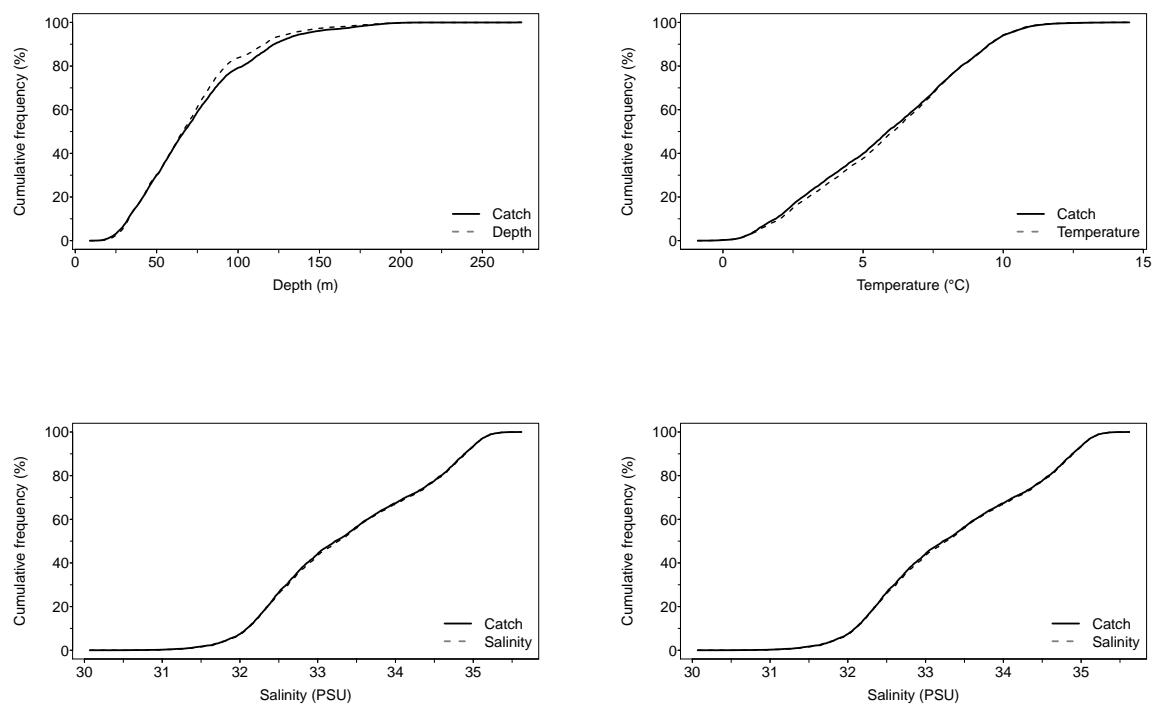


Figure 7.9E. Catch distribution by depth, temperature and salinity of American plaice.

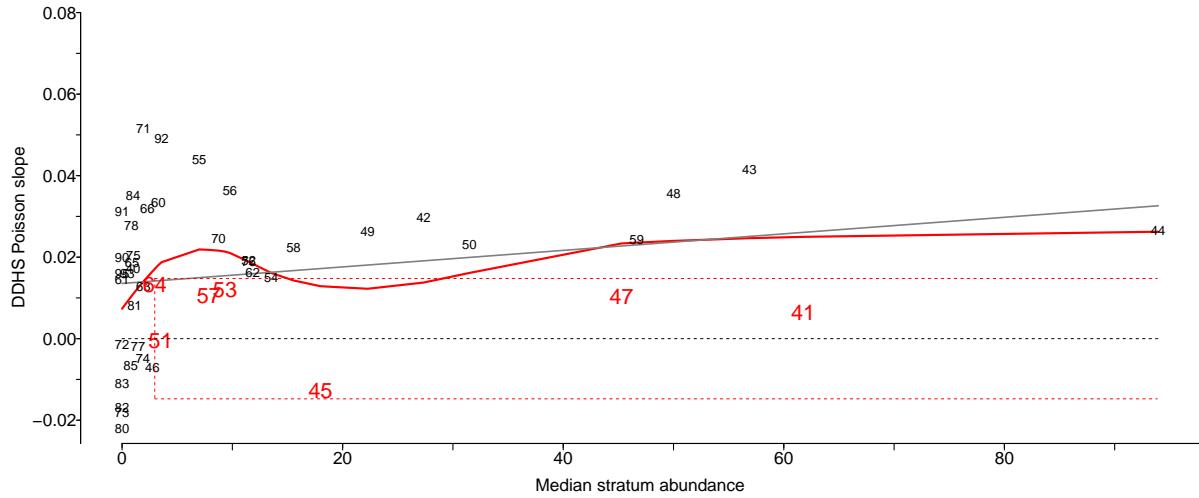


Figure 7.9F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for American plaice.

## 7.10 Witch flounder (*Ple grise*) - species code 41 (category LF)

Scientific name: [Glyptocephalus cynoglossus](#)

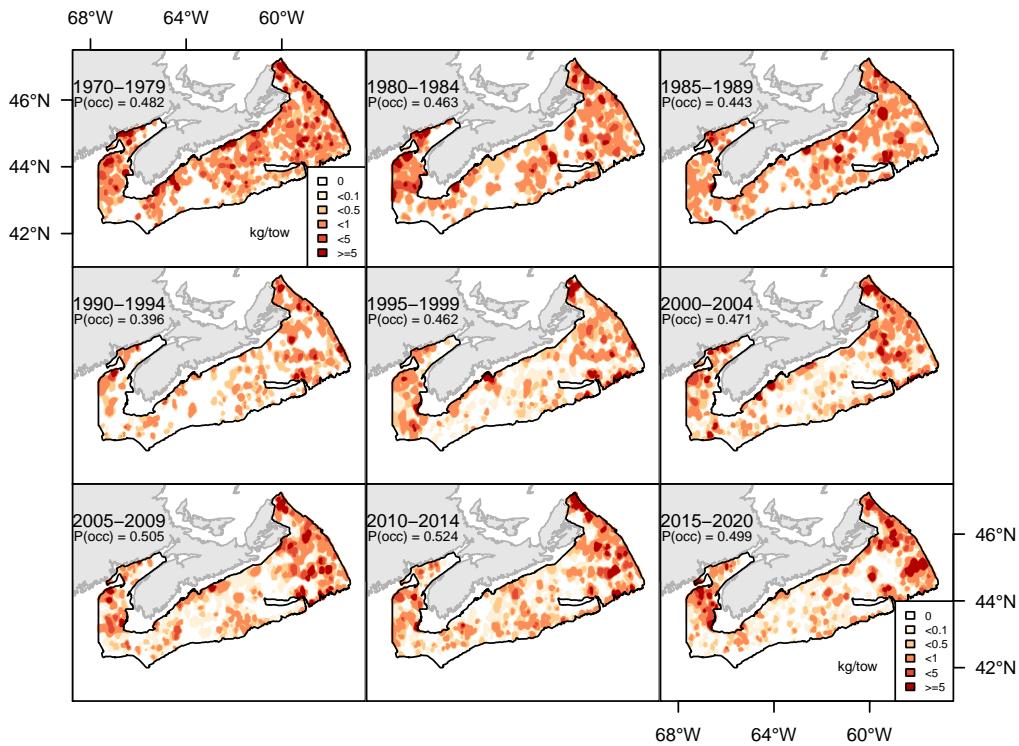


Figure 7.10A. Inverse distance weighted distribution of catch biomass (kg/tow) for Witch flounder.

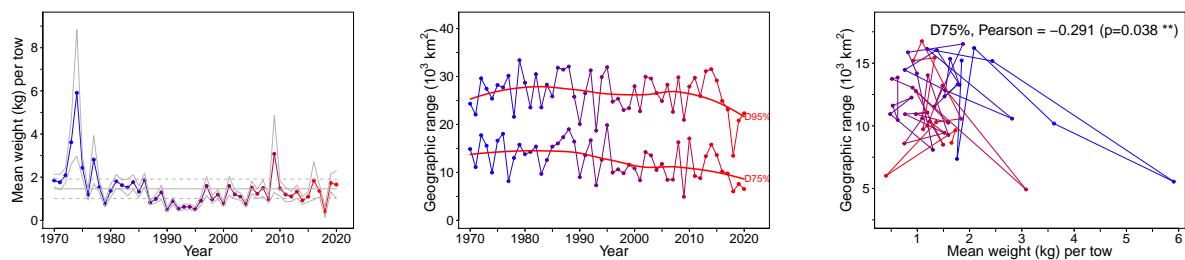


Figure 7.10B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Witch flounder.

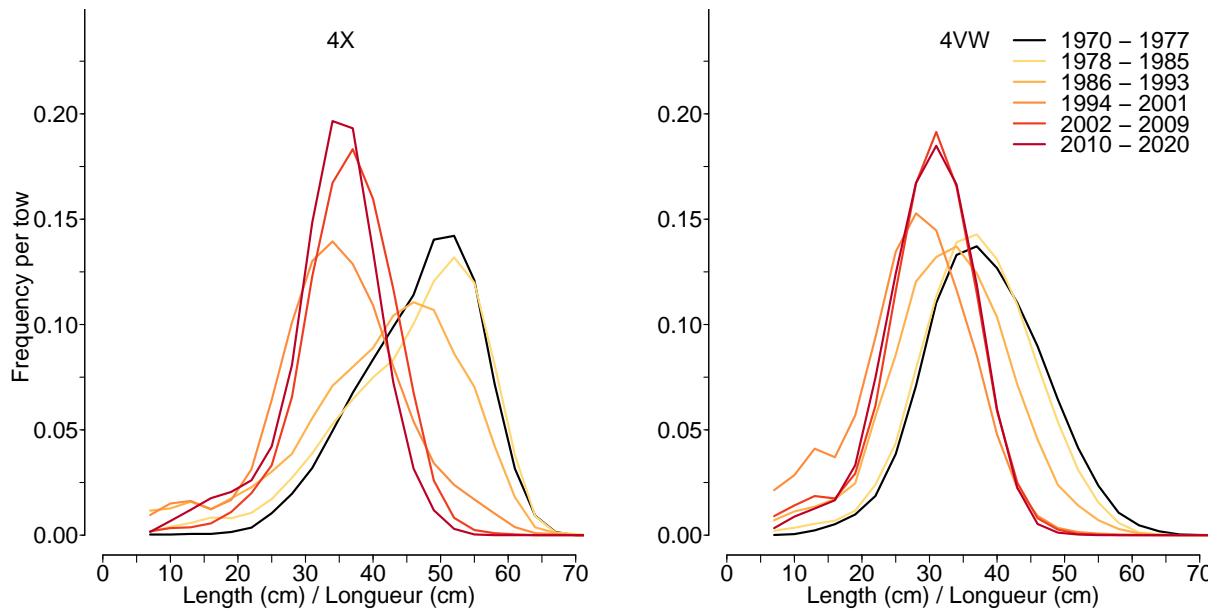


Figure 7.10C. Length frequency distribution in NAFO units 4X and 4VW for Witch flounder.

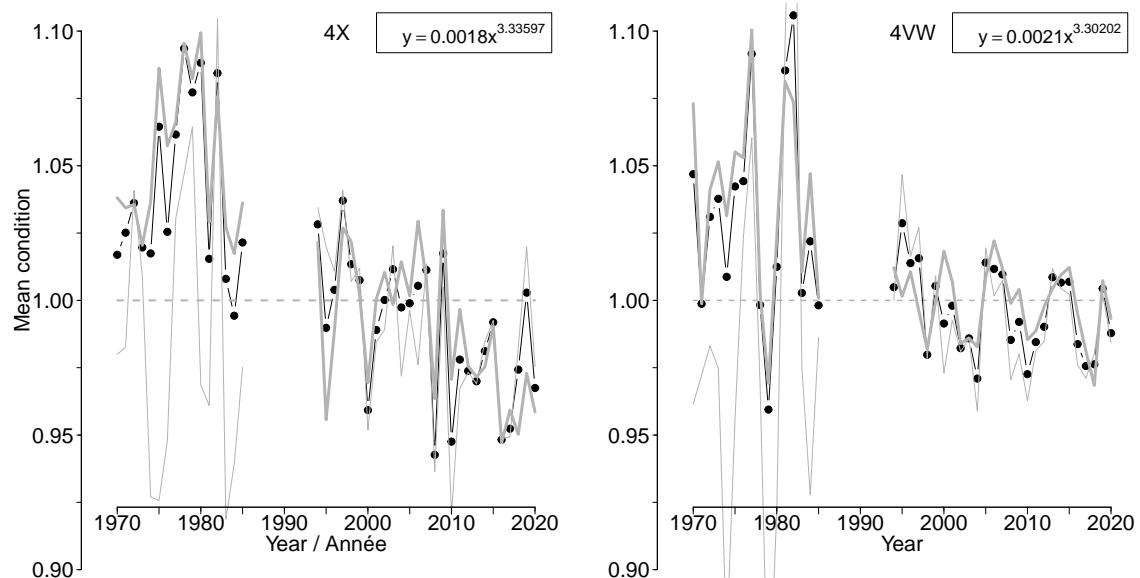


Figure 7.10D. Average fish condition in NAFO units 4X and 4VW for Witch flounder.

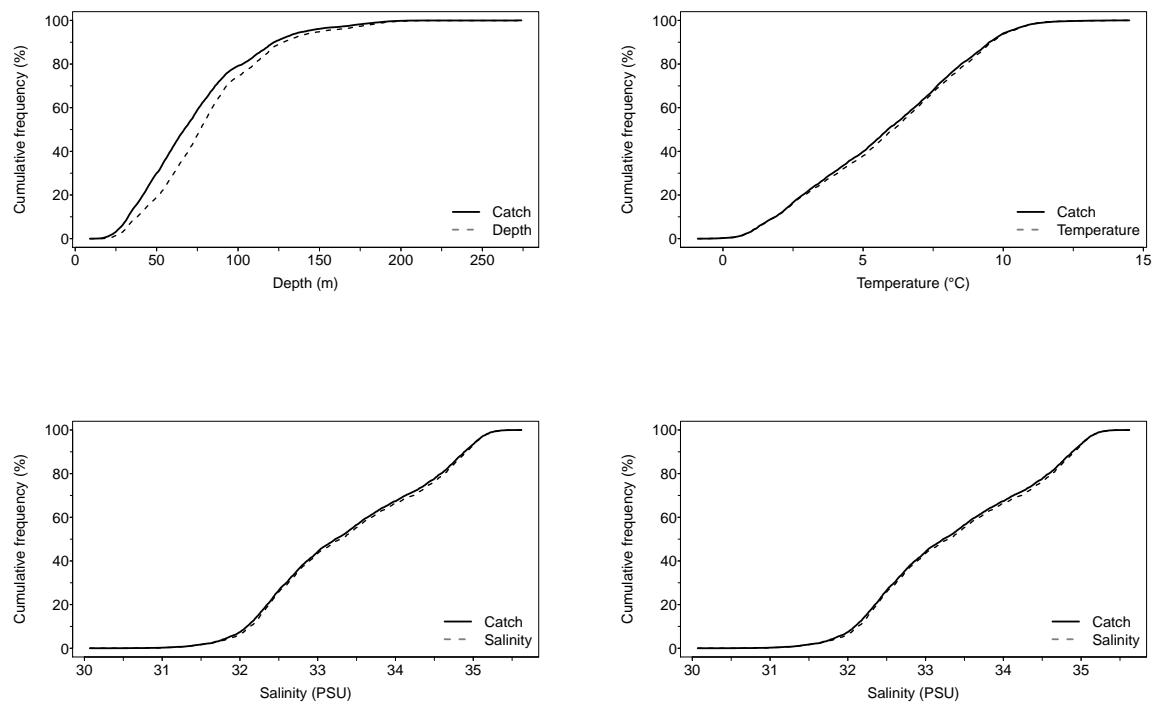


Figure 7.10E. Catch distribution by depth, temperature and salinity of Witch flounder.

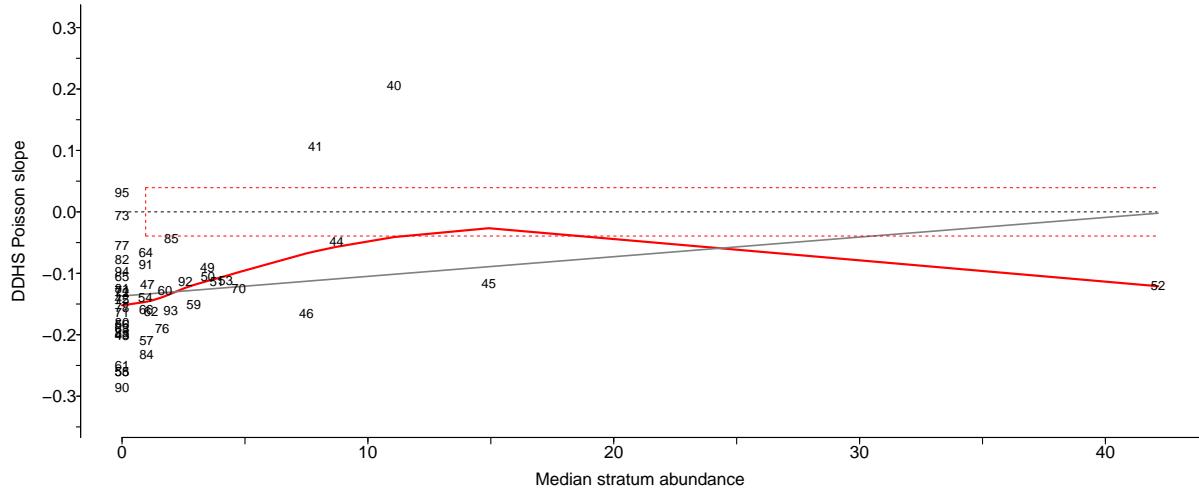


Figure 7.10F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Witch flounder.

## 7.11 Yellowtail flounder (Limande à queue jaune) - species code 42 (category LF)

Scientific name: [Limanda ferruginea](#)

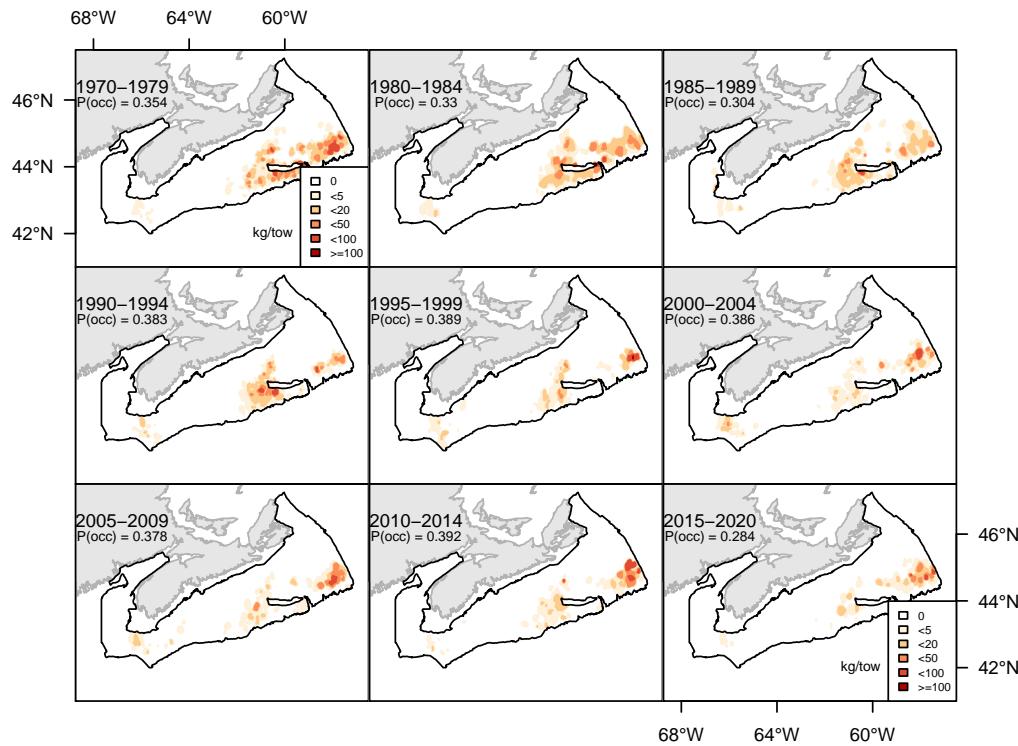


Figure 7.11A. Inverse distance weighted distribution of catch biomass (kg/tow) for Yellowtail flounder.

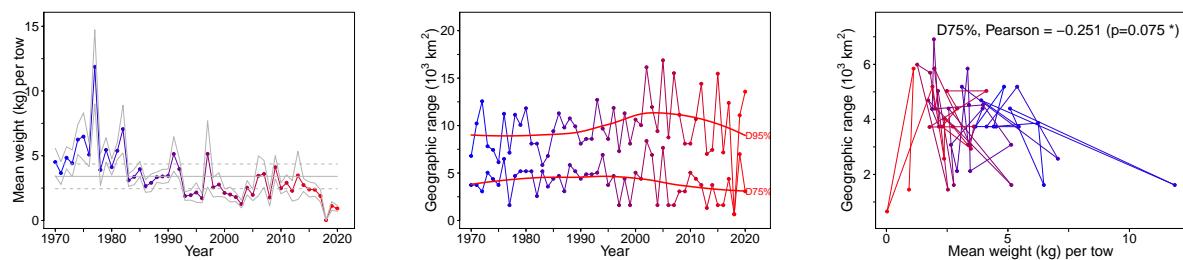


Figure 7.11B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Yellowtail flounder.

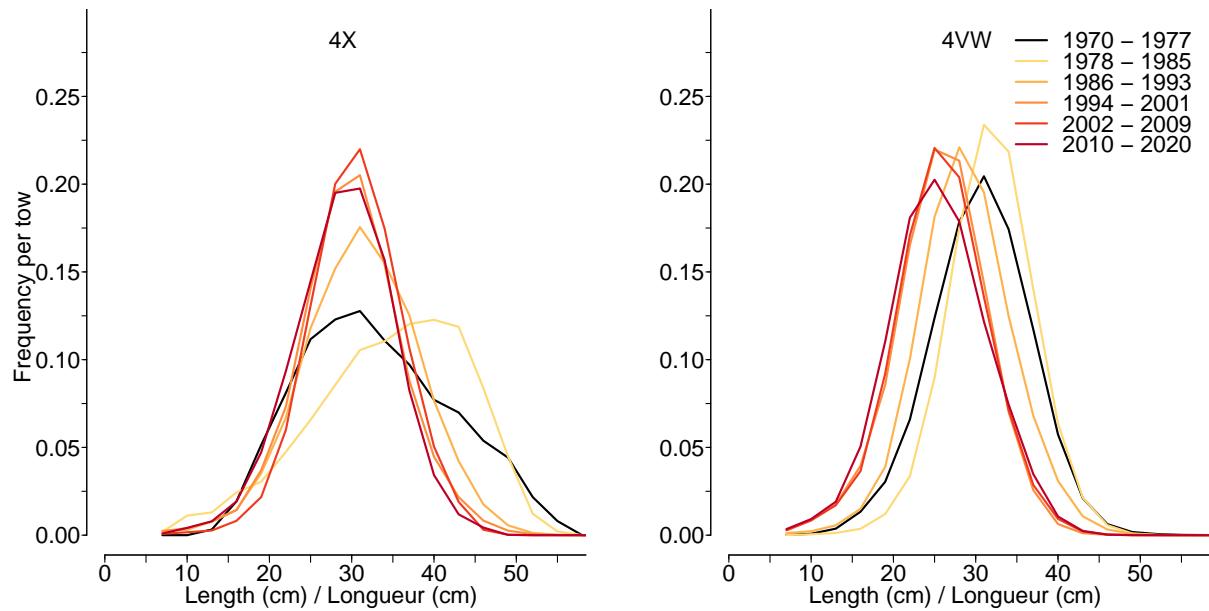


Figure 7.11C. Length frequency distribution in NAFO units 4X and 4VW for Yellowtail flounder.

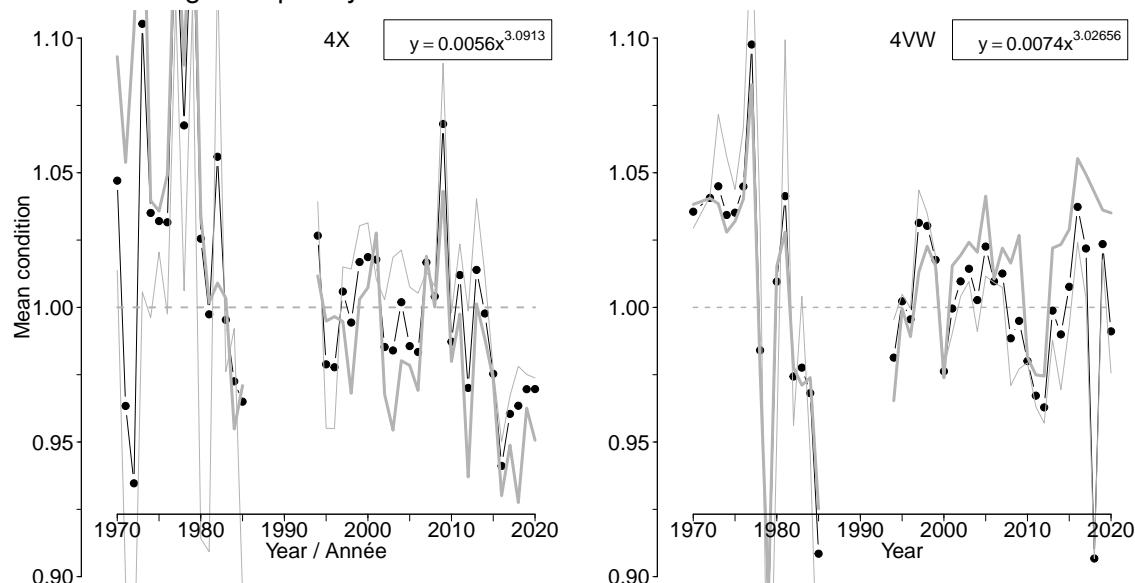


Figure 7.11D. Average fish condition in NAFO units 4X and 4VW for Yellowtail flounder.

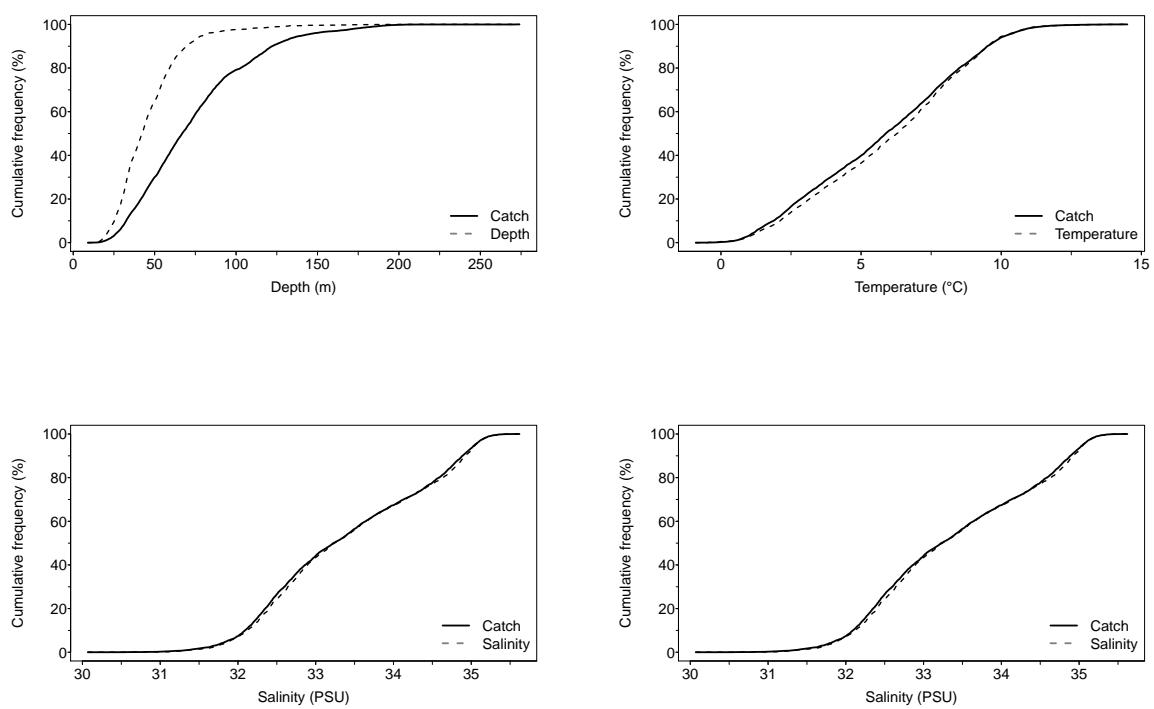


Figure 7.11E. Catch distribution by depth, temperature and salinity of Yellowtail flounder.

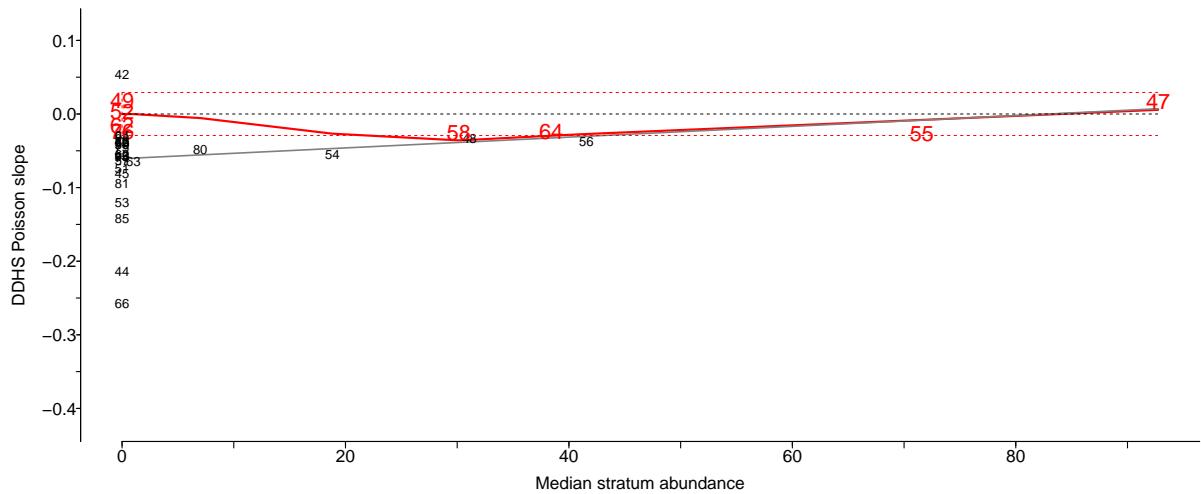


Figure 7.11F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Yellowtail flounder.

## 7.12 Winter flounder (Limande-plie rouge) - species code 43 (category LF)

Scientific name: [Pseudopleuronectes americanus](#)

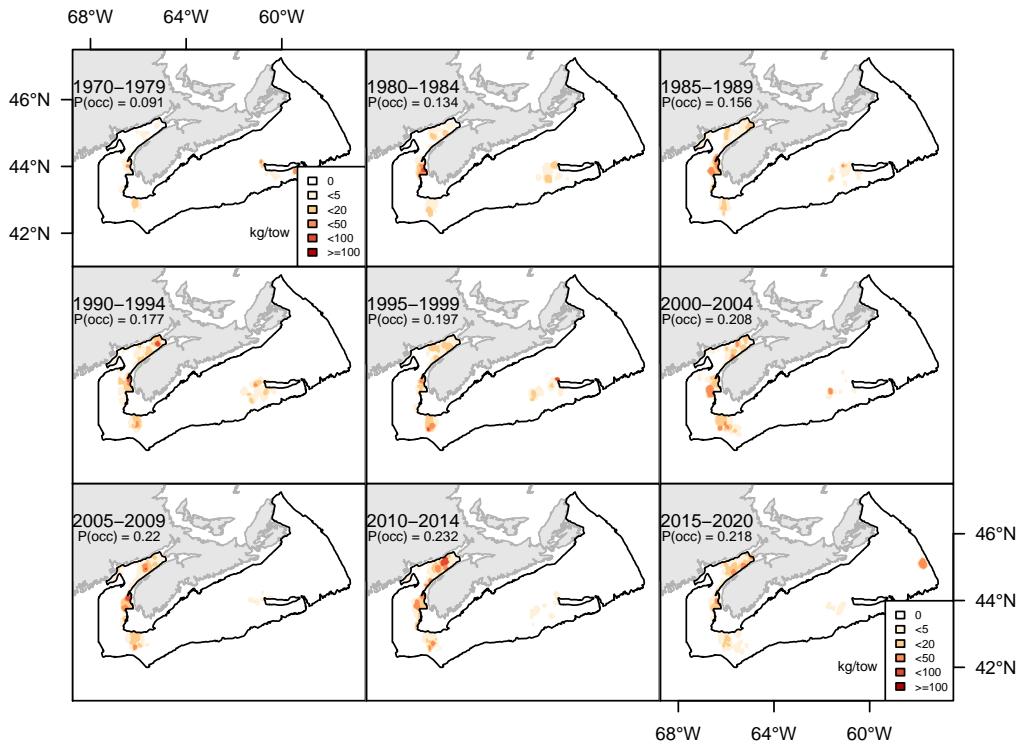


Figure 7.12A. Inverse distance weighted distribution of catch biomass (kg/tow) for Winter flounder.

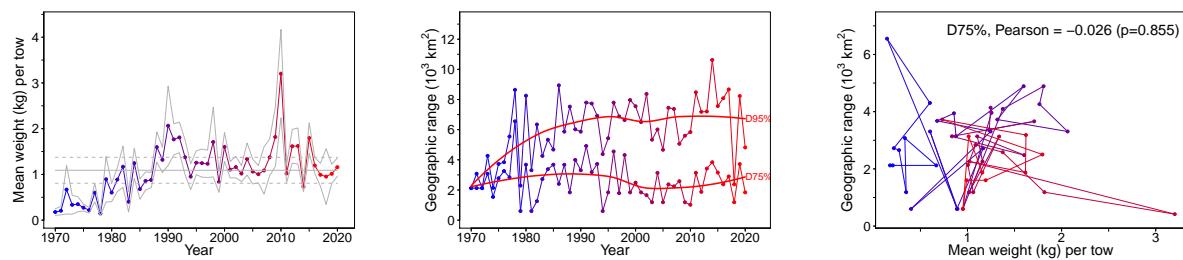


Figure 7.12B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Winter flounder.

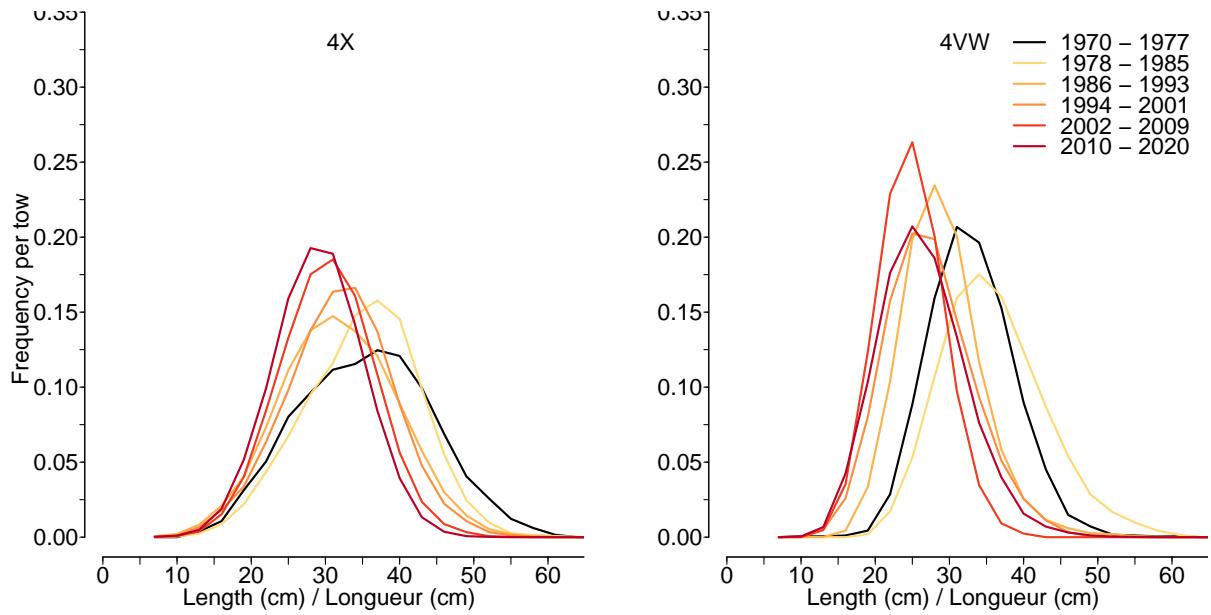


Figure 7.12C. Length frequency distribution in NAFO units 4X and 4VW for Winter flounder.

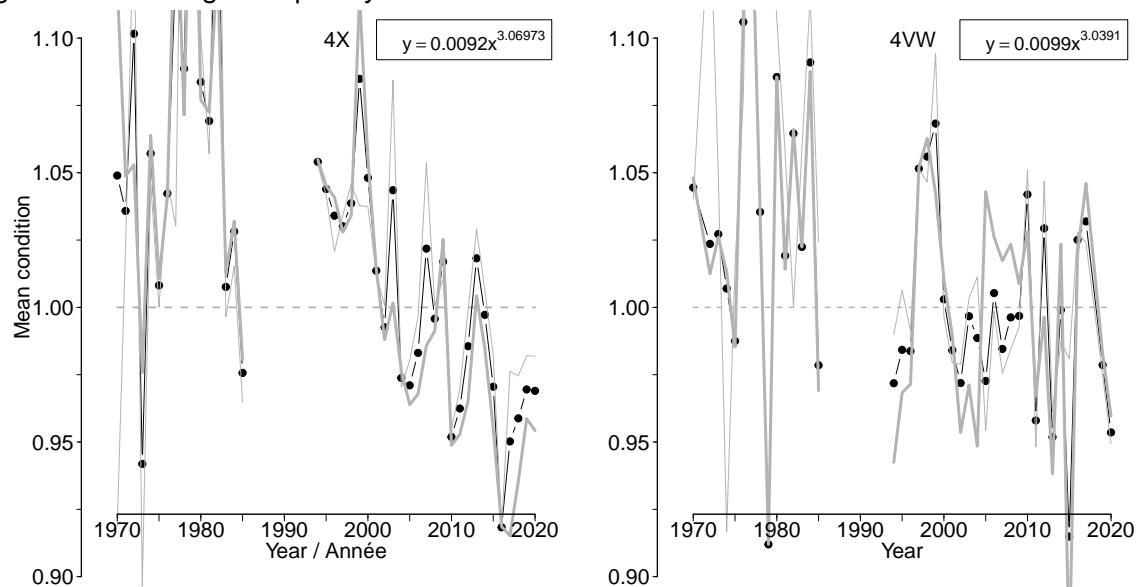


Figure 7.12D. Average fish condition in NAFO units 4X and 4VW for Winter flounder.

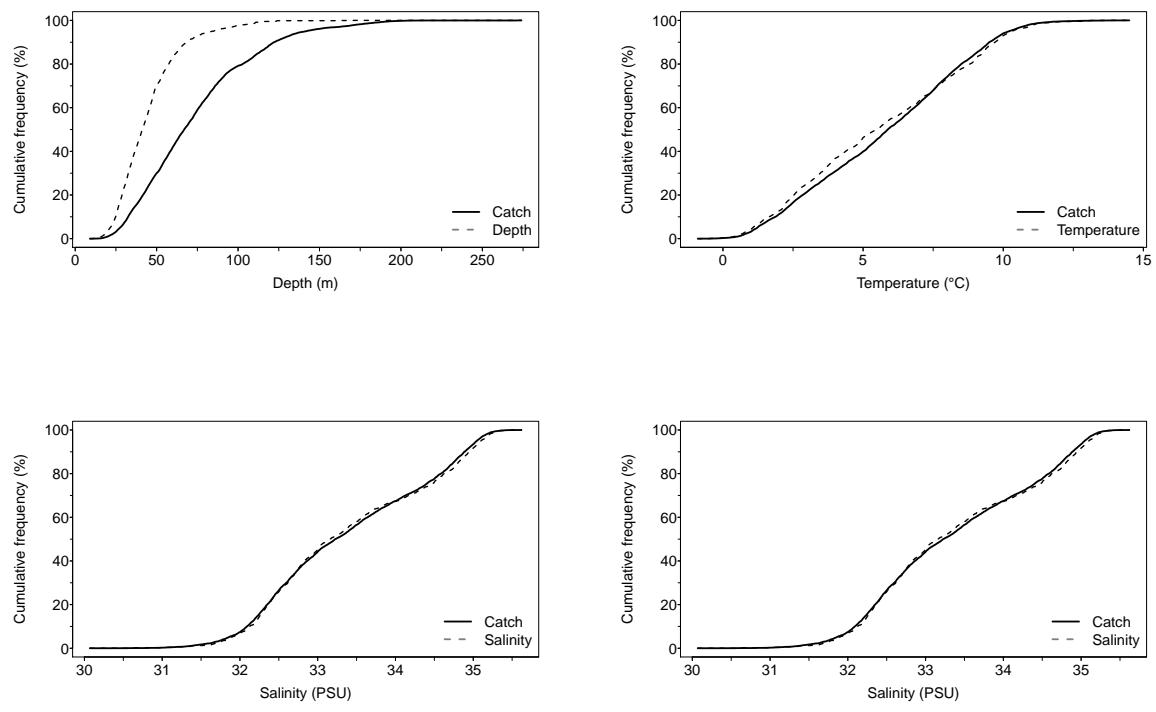


Figure 7.12E. Catch distribution by depth, temperature and salinity of Winter flounder.

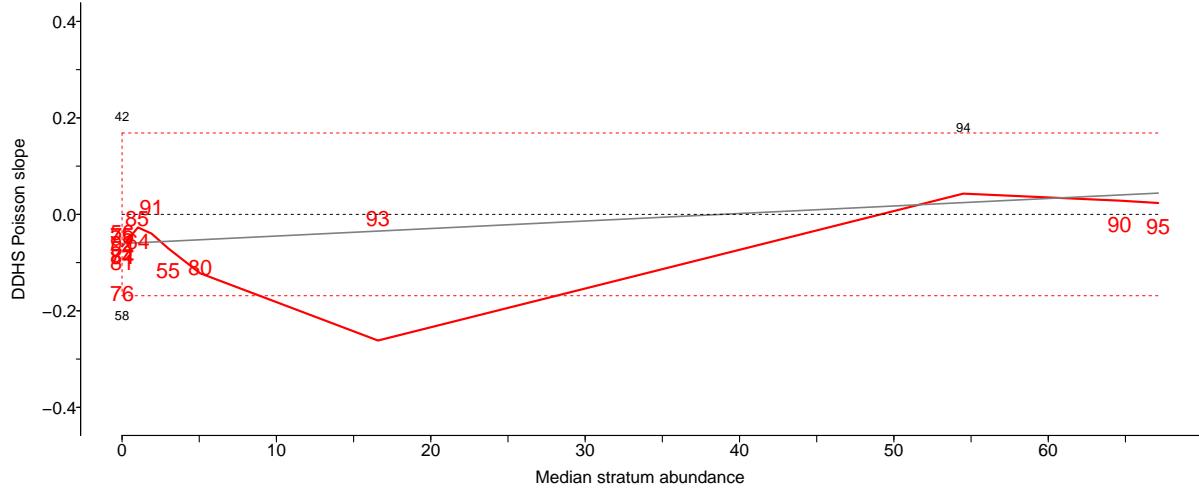


Figure 7.12F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Winter flounder.

## 7.13 Atlantic wolffish (Loup atlantique) - species code 50 (category LF)

Scientific name: [Anarhichas lupus](#)

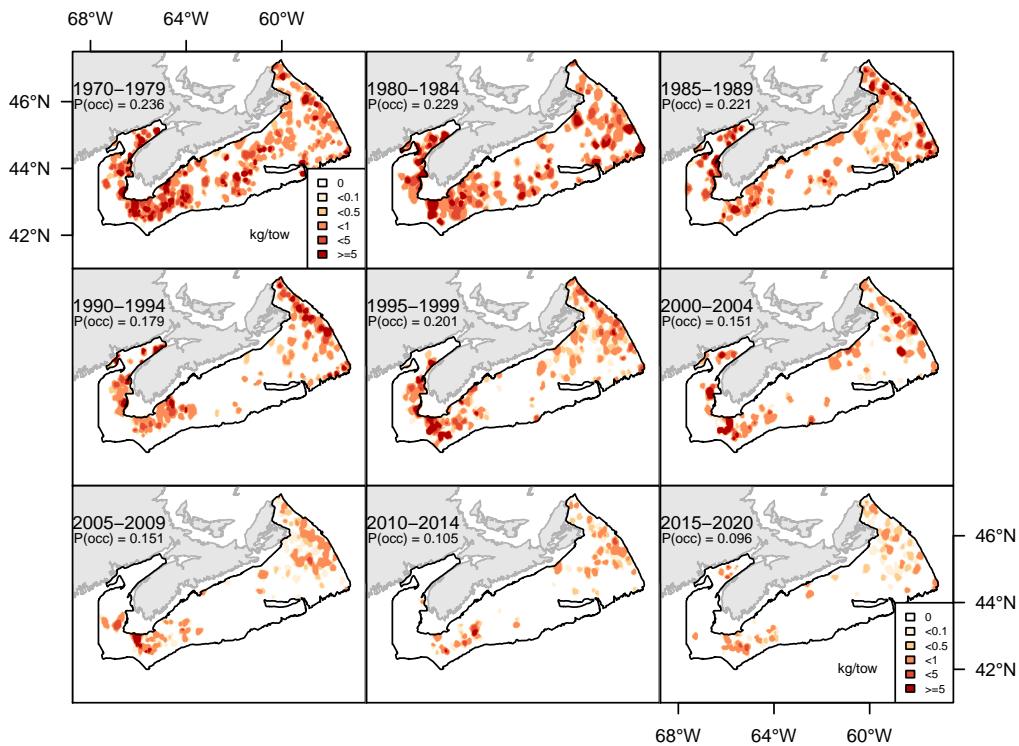


Figure 7.13A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic wolffish.

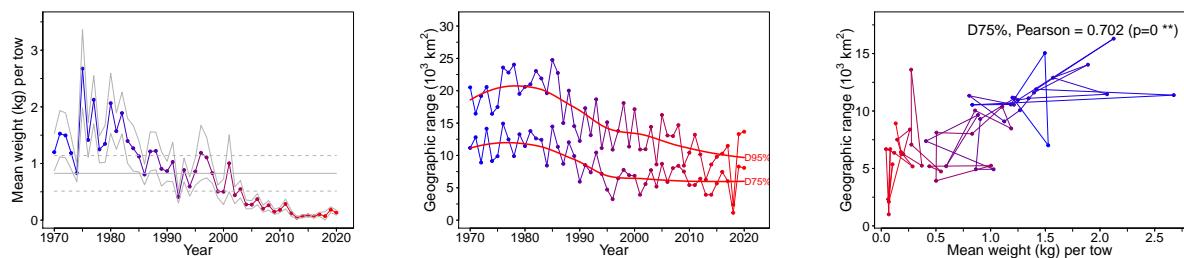


Figure 7.13B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic wolffish.

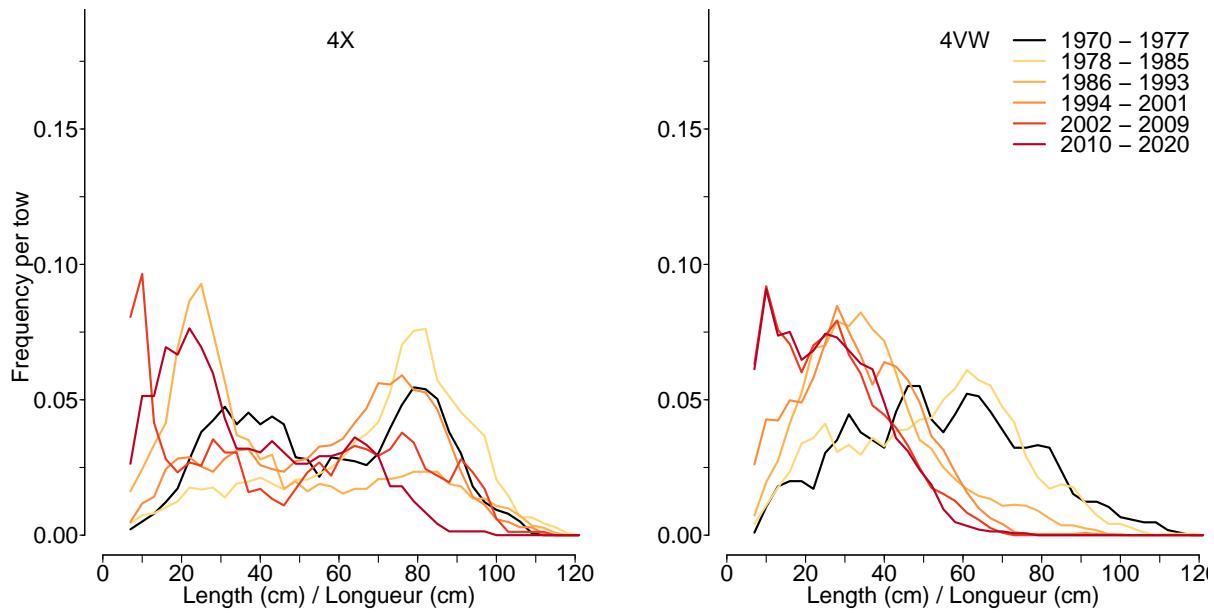


Figure 7.13C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic wolffish.

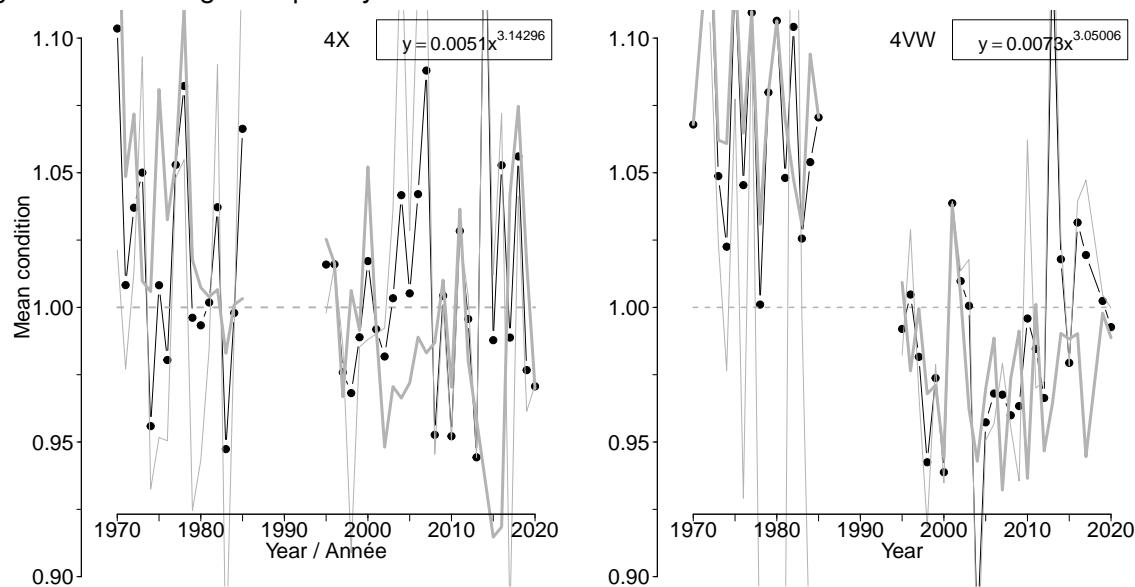


Figure 7.13D. Average fish condition in NAFO units 4X and 4VW for Atlantic wolffish.

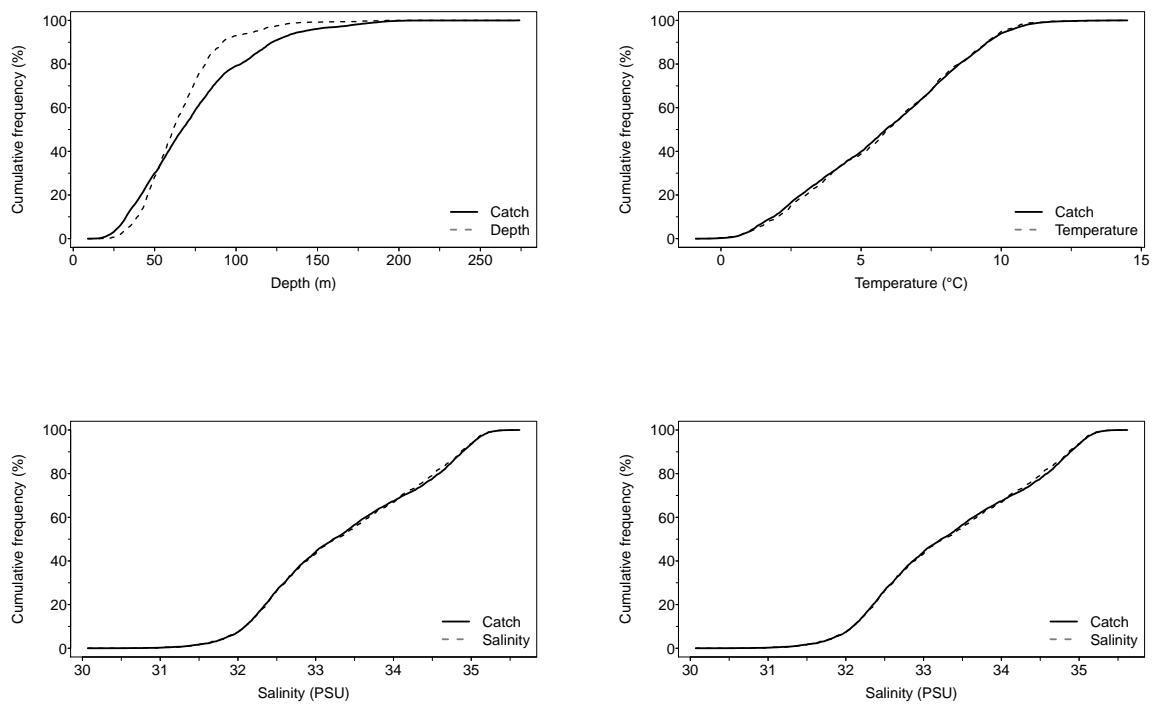


Figure 7.13E. Catch distribution by depth, temperature and salinity of Atlantic wolffish.

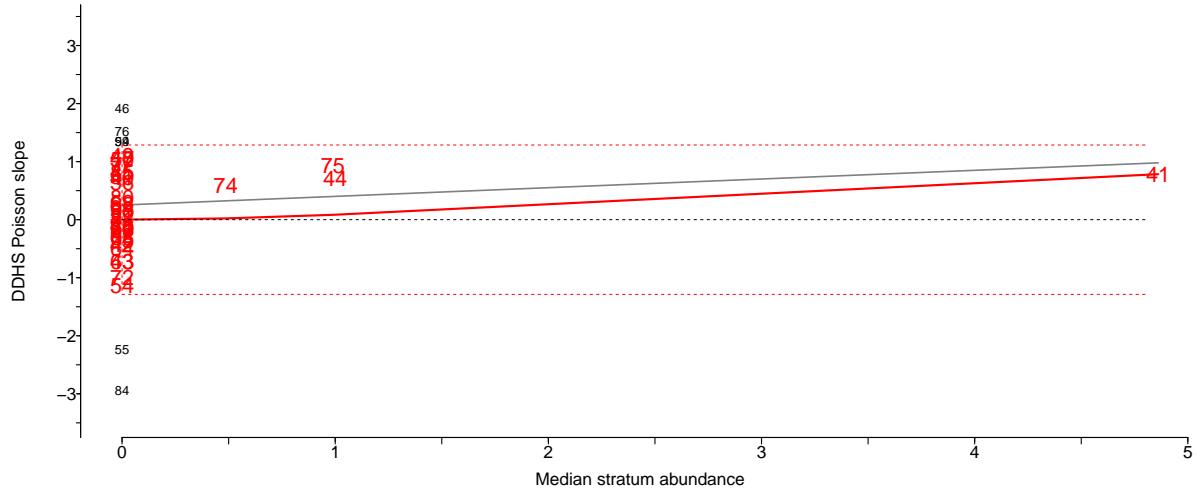


Figure 7.13F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Atlantic wolffish.

## 7.14 Atlantic herring (Hareng de l'Atlantique) - species code 60 (category LF)

Scientific name: [Clupea harengus](#)

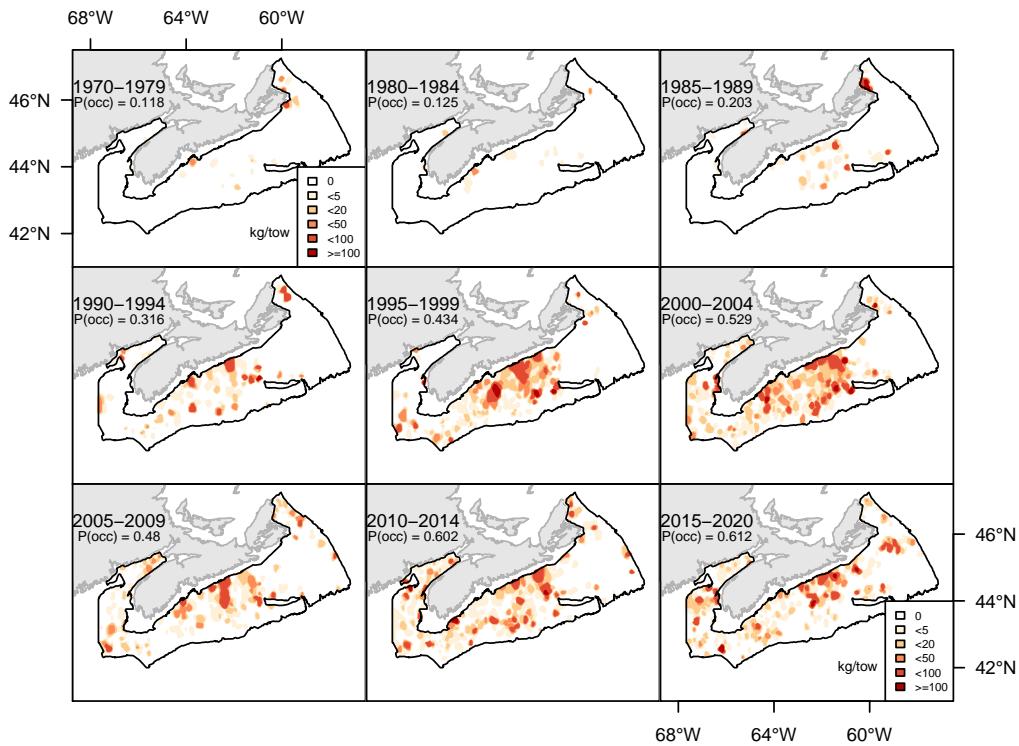


Figure 7.14A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic herring.

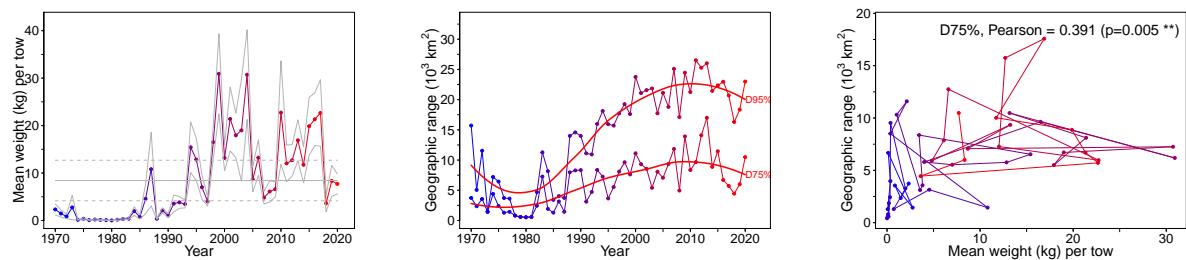


Figure 7.14B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic herring.

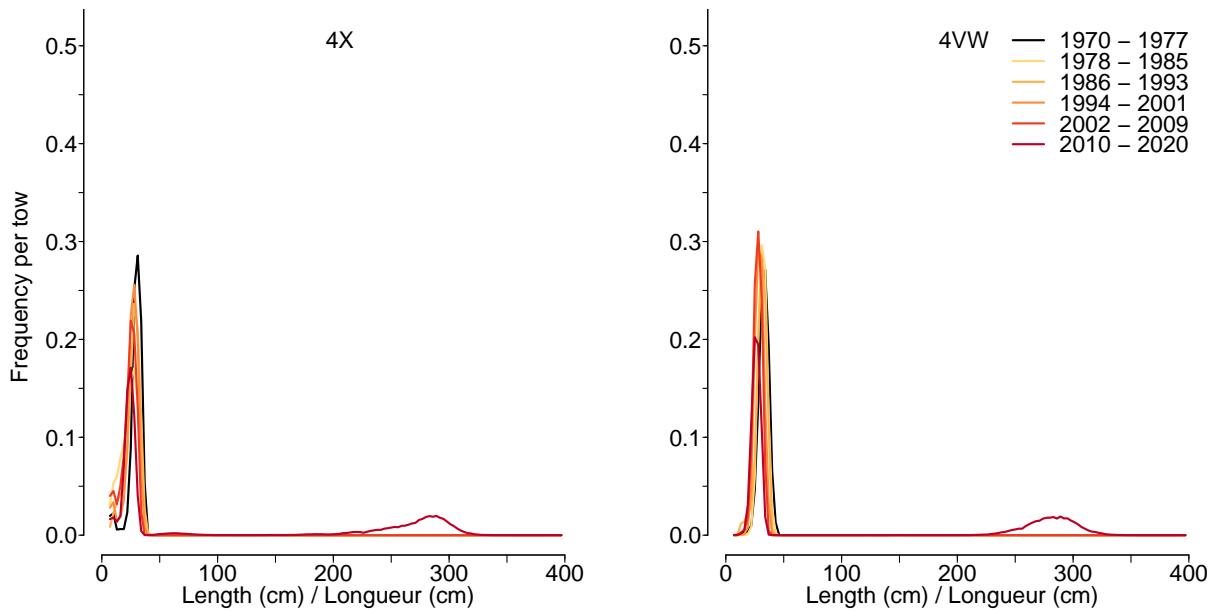


Figure 7.14C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic herring.

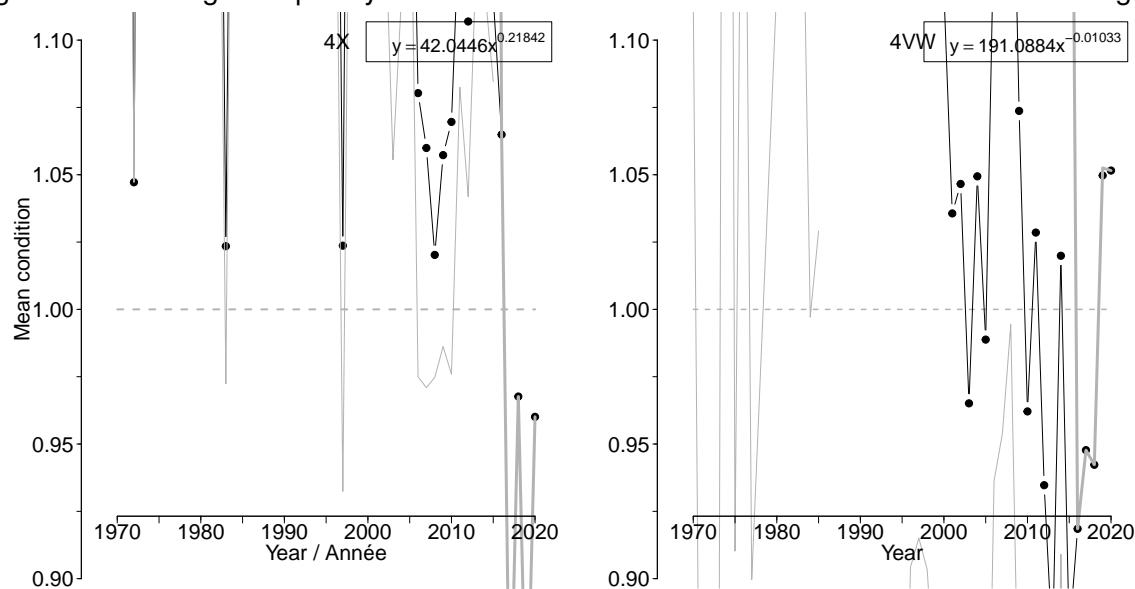


Figure 7.14D. Average fish condition in NAFO units 4X and 4VW for Atlantic herring.

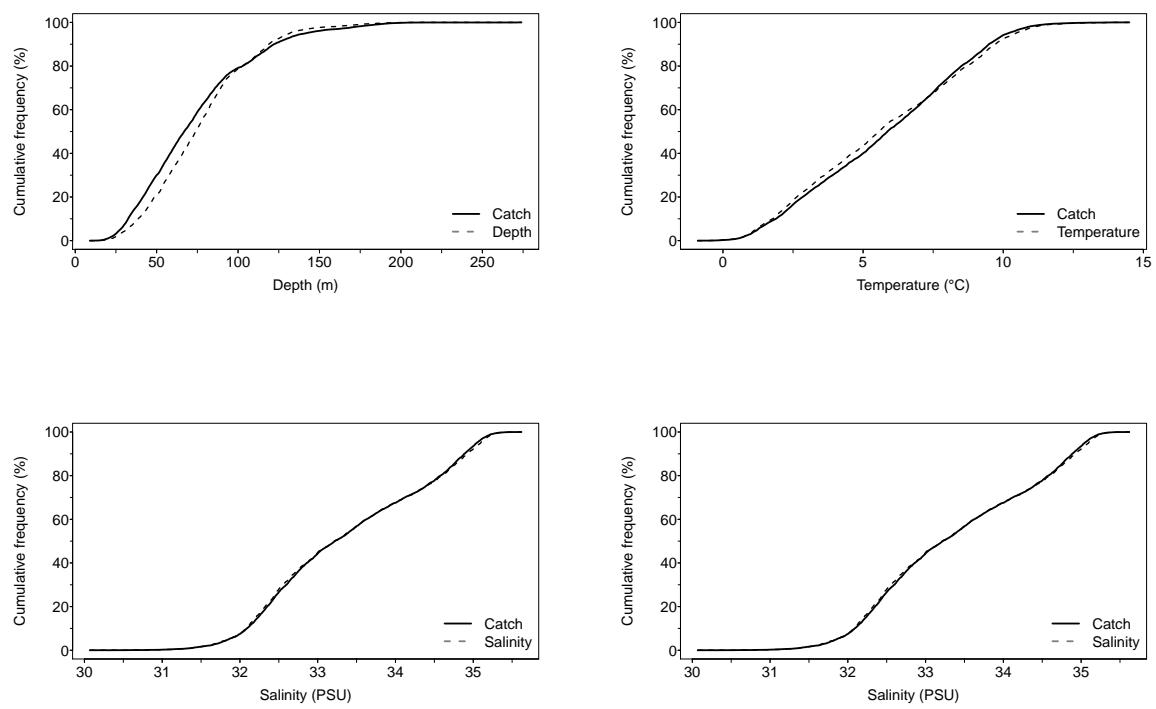


Figure 7.14E. Catch distribution by depth, temperature and salinity of Atlantic herring.

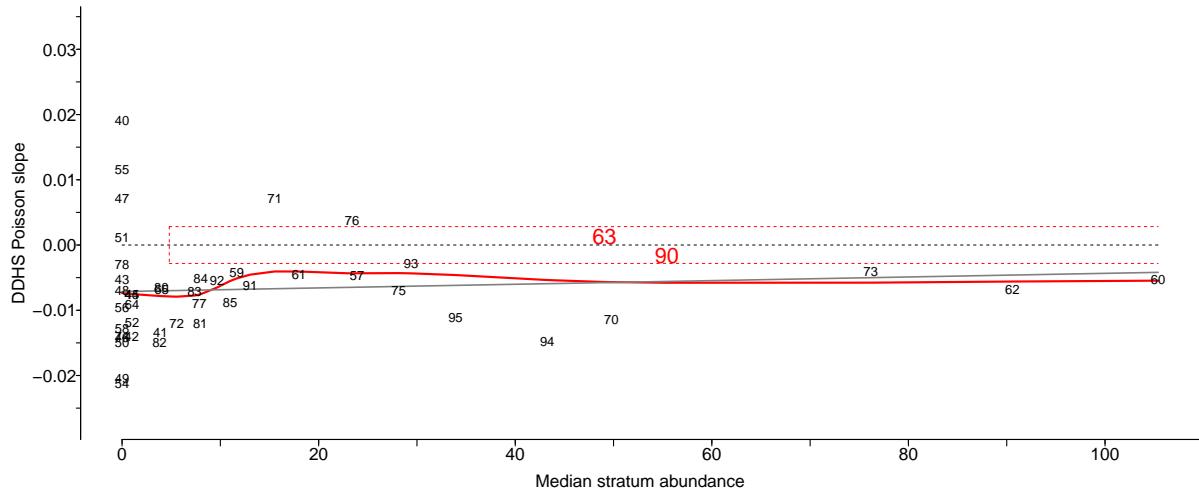


Figure 7.14F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Atlantic herring.

## 7.15 Longhorn sculpin (Chaboisseau à dix-huit épines) - species code 300 (category LF)

Scientific name: [Myoxocephalus octodecemspiniferus](#)

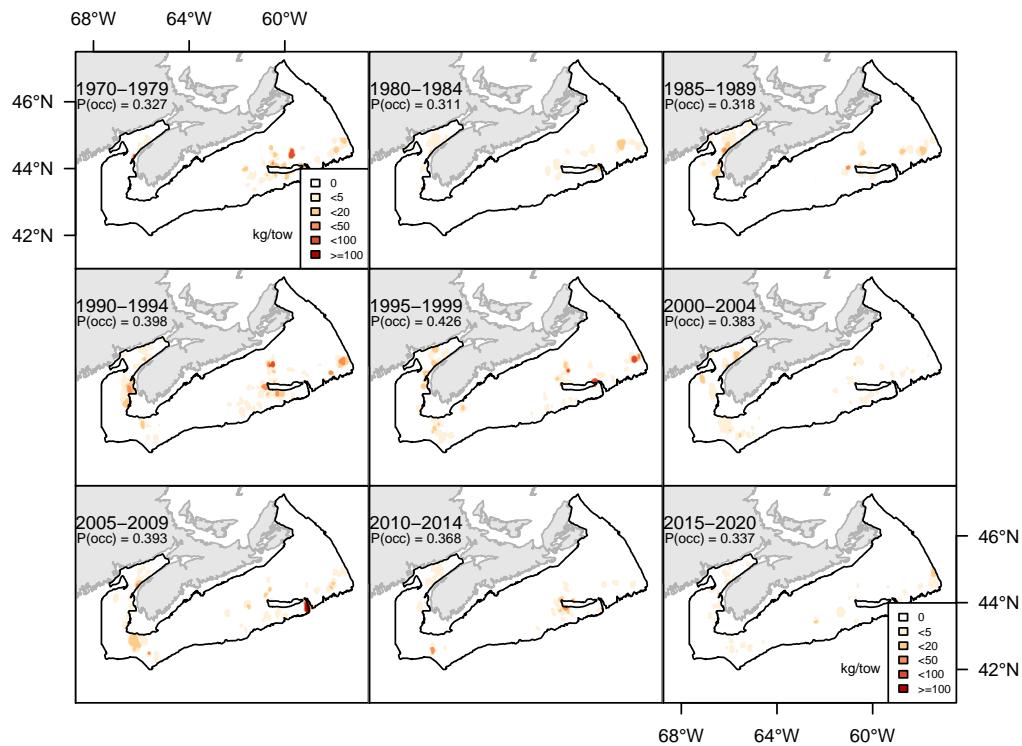


Figure 7.15A. Inverse distance weighted distribution of catch biomass (kg/tow) for Longhorn sculpin.

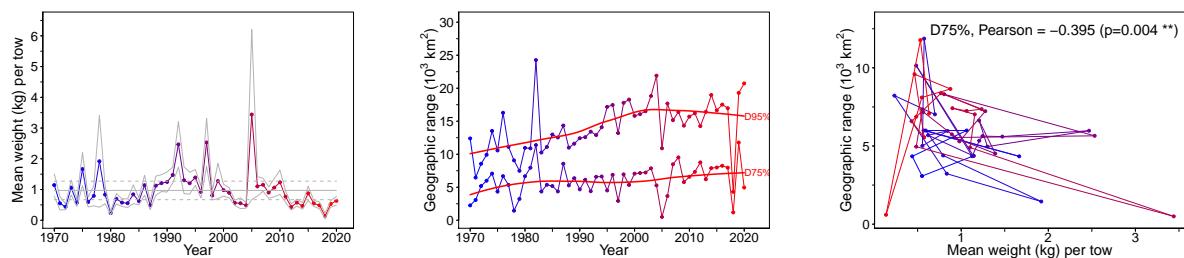


Figure 7.15B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Longhorn sculpin.

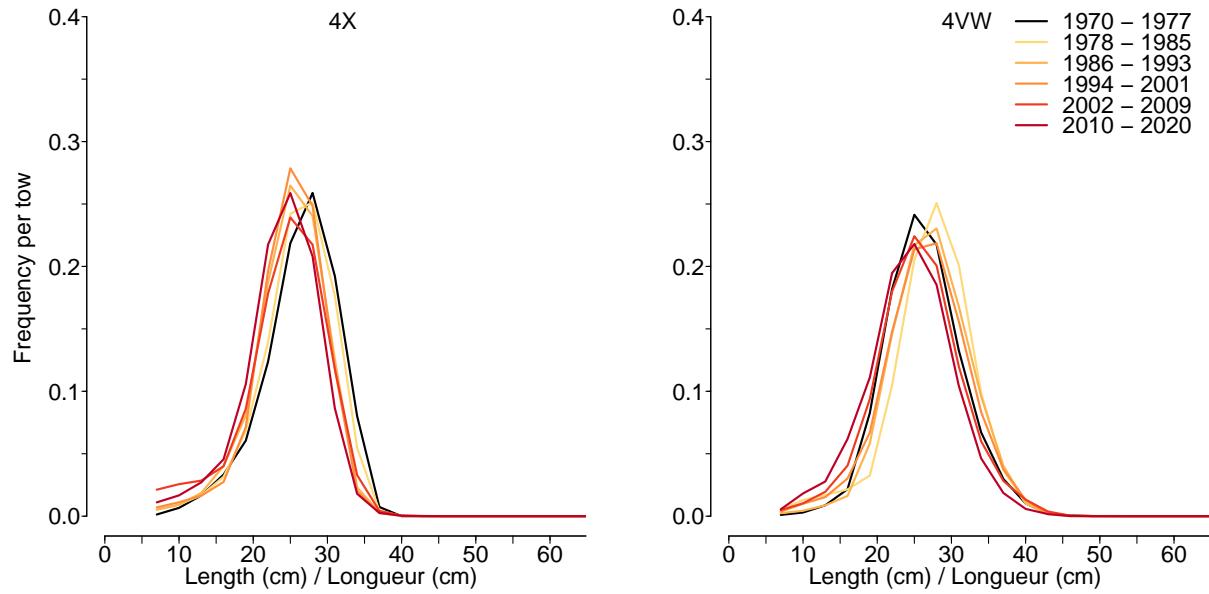


Figure 7.15C. Length frequency distribution in NAFO units 4X and 4VW for Longhorn sculpin.

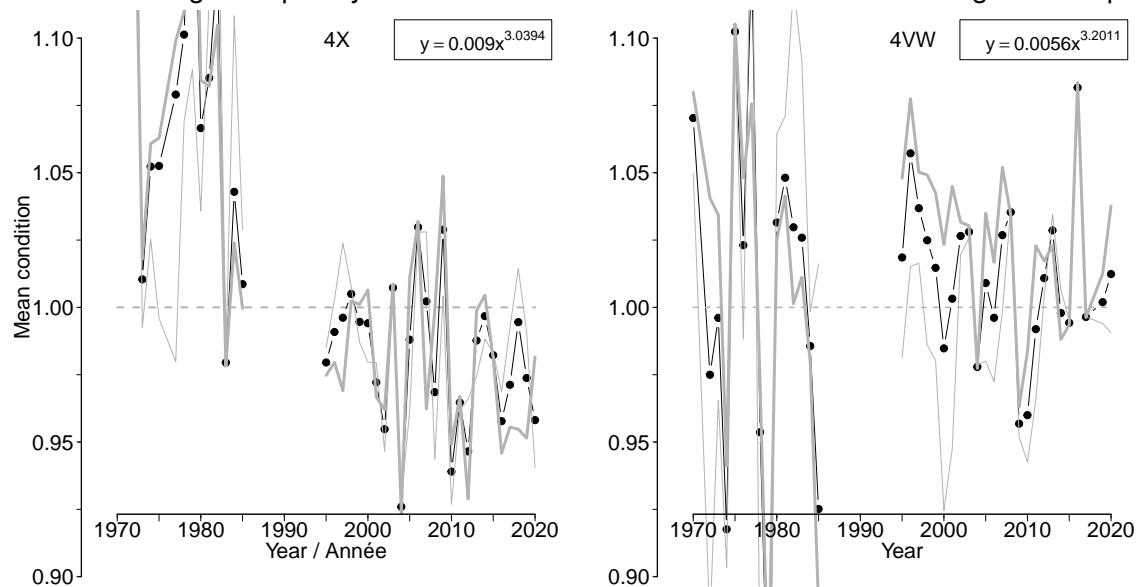


Figure 7.15D. Average fish condition in NAFO units 4X and 4VW for Longhorn sculpin.

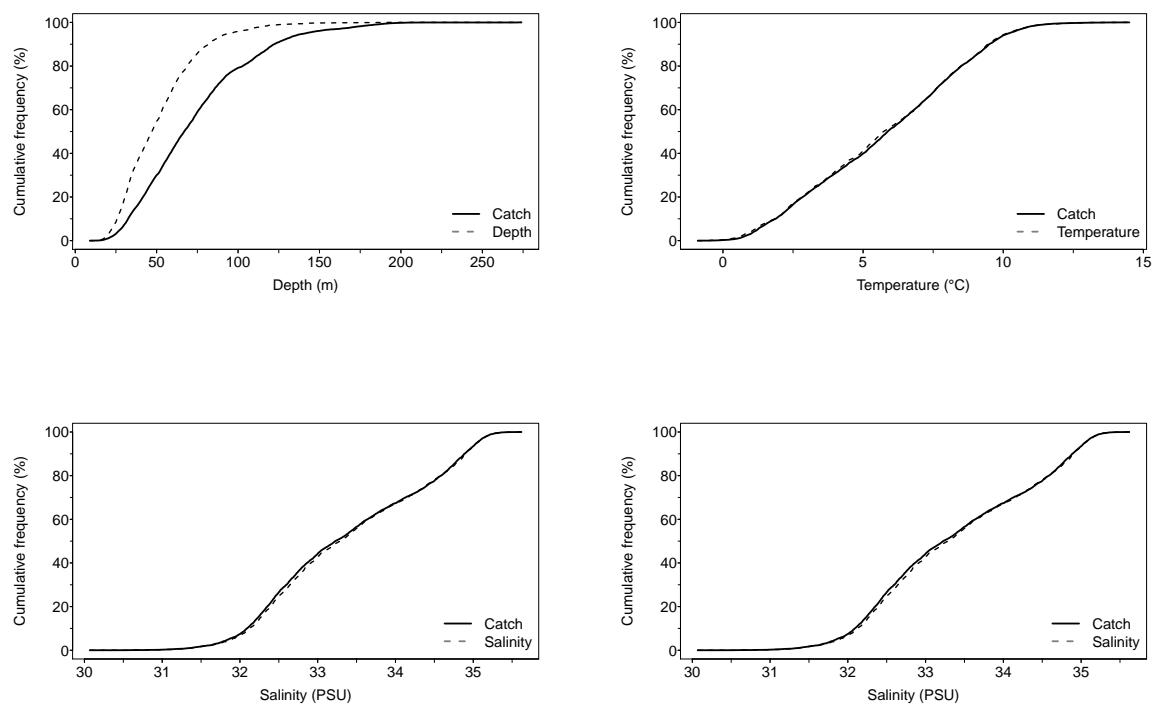


Figure 7.15E. Catch distribution by depth, temperature and salinity of Longhorn sculpin.

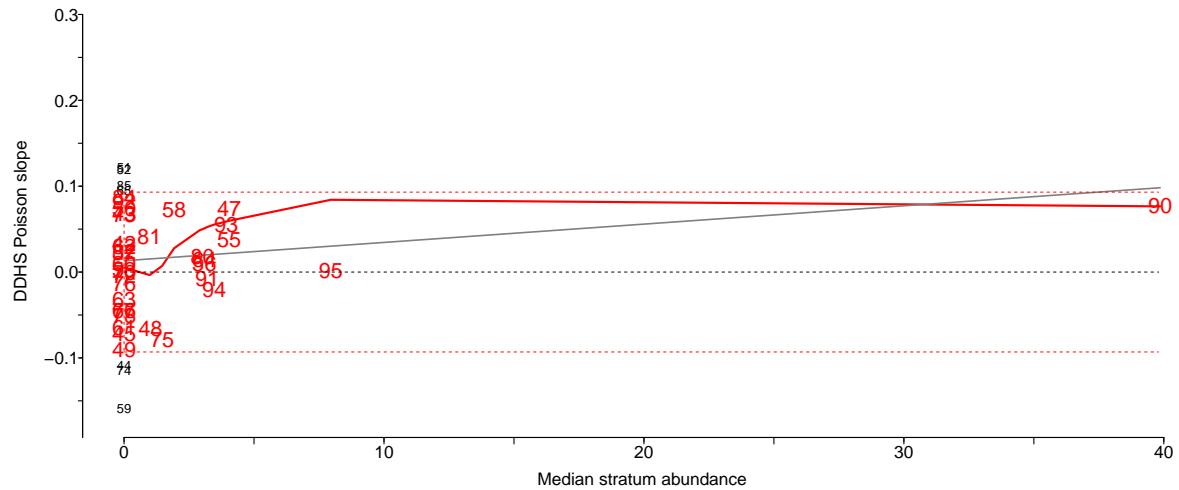


Figure 7.15F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Longhorn sculpin.

## 7.16 Moustache sculpin (Faux-trigle armé) - species code 304 (category LF)

Scientific name: [Triglops murrayi](#)

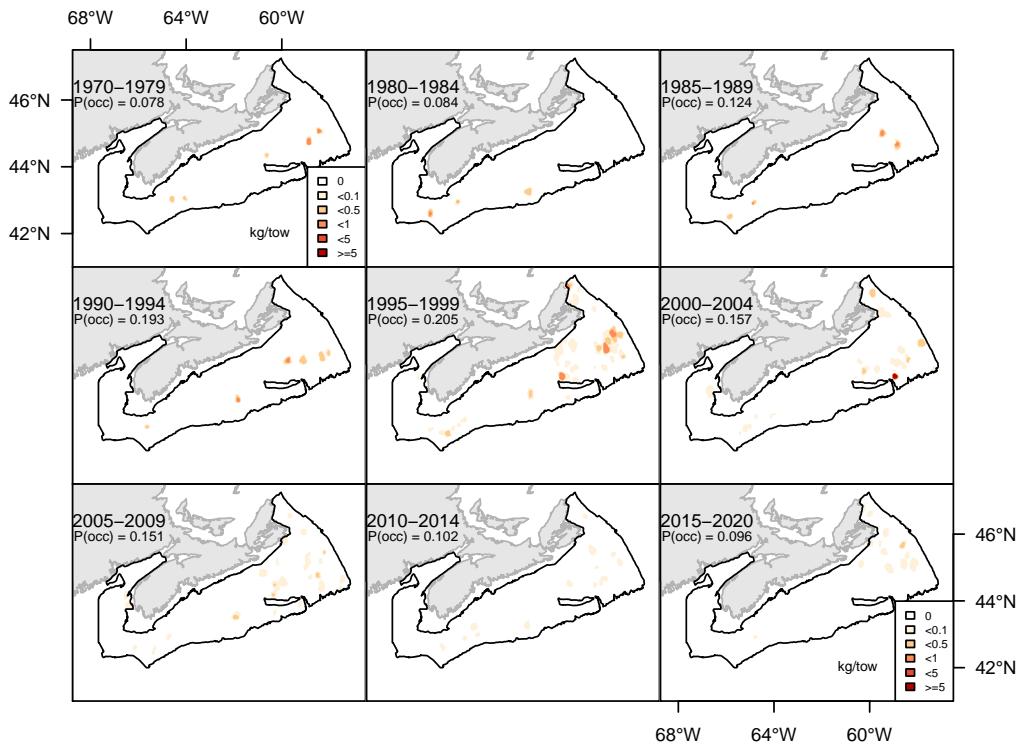


Figure 7.16A. Inverse distance weighted distribution of catch biomass (kg/tow) for Moustache sculpin.

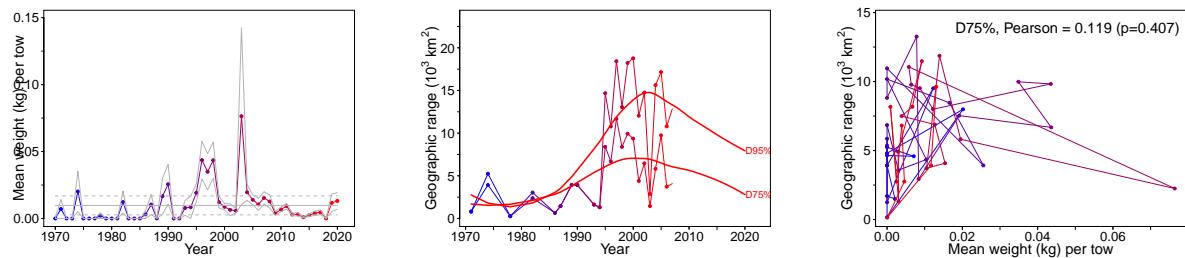


Figure 7.16B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Moustache sculpin.

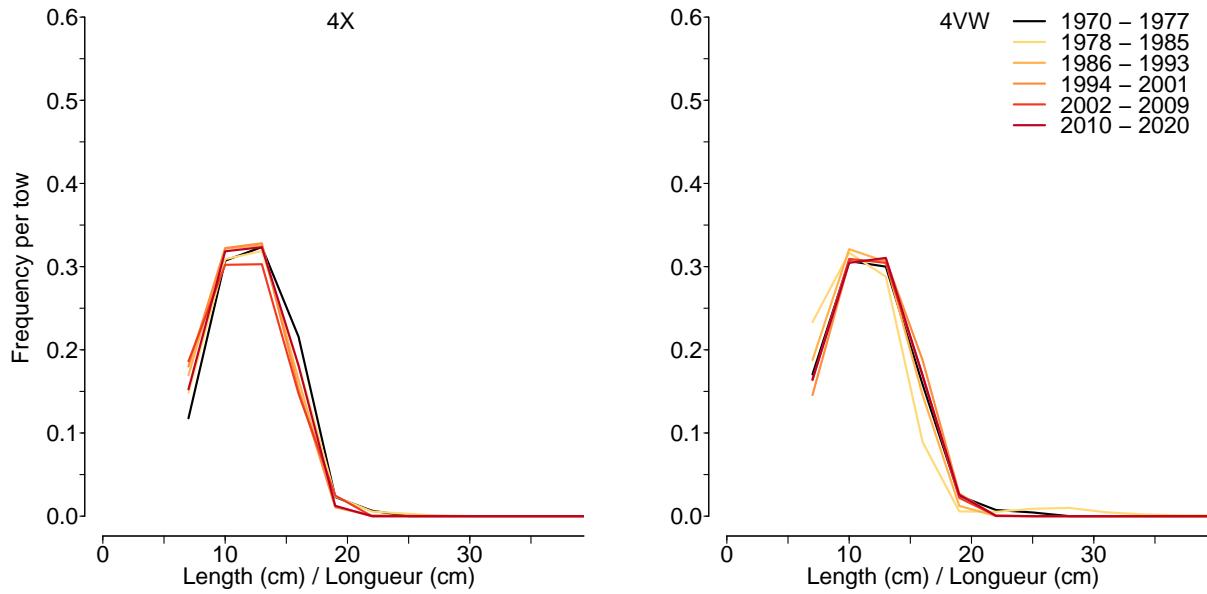


Figure 7.16C. Length frequency distribution in NAFO units 4X and 4VW for Moustache sculpin.

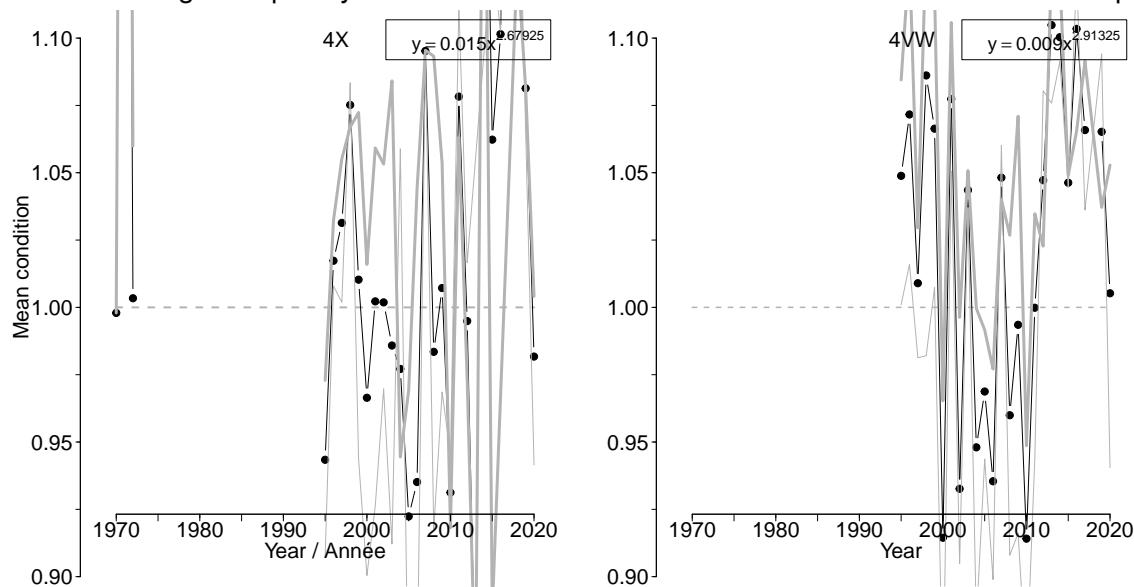


Figure 7.16D. Average fish condition in NAFO units 4X and 4VW for Moustache sculpin.

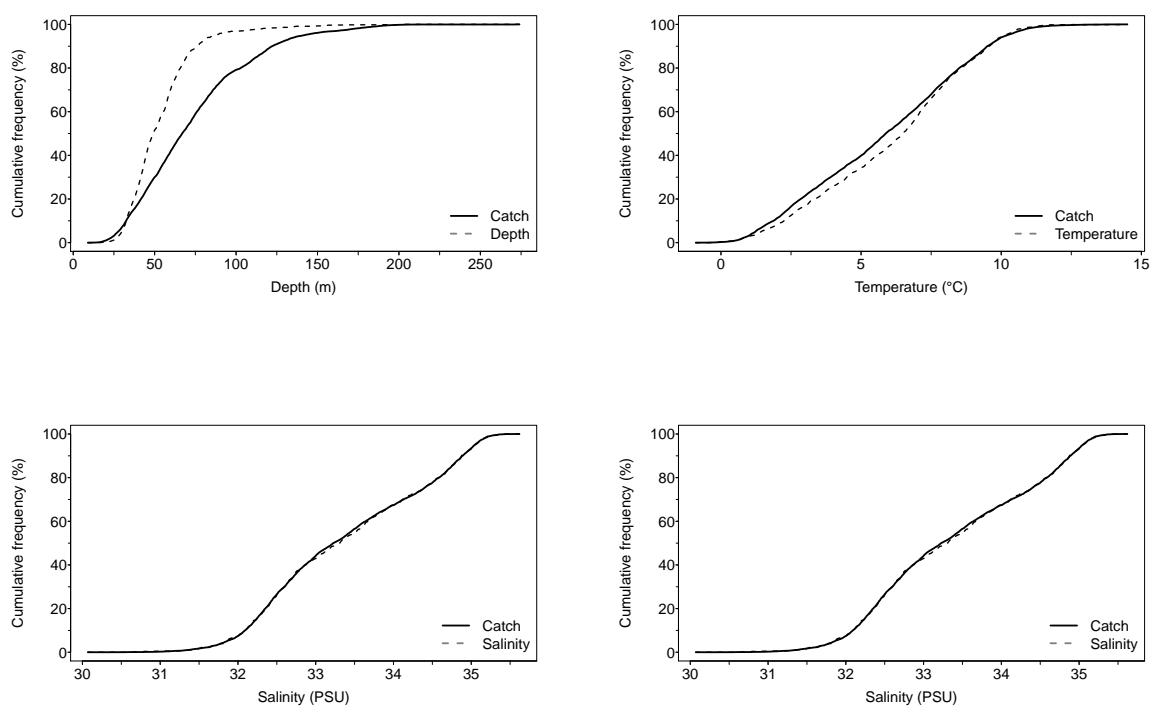


Figure 7.16E. Catch distribution by depth, temperature and salinity of Moustache sculpin.

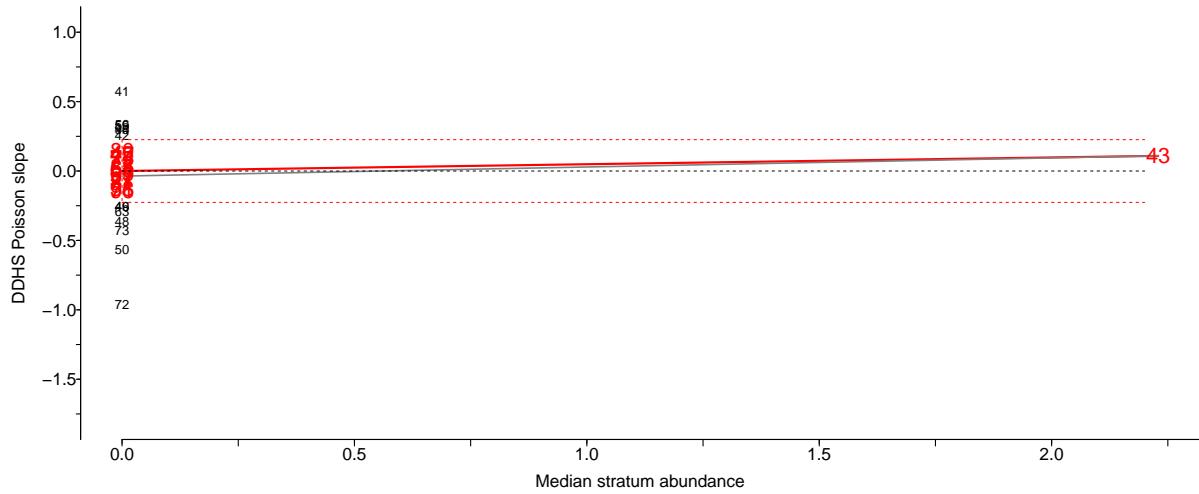


Figure 7.16F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Moustache sculpin.

## 7.17 Sea raven (Hémithriptère atlantique) - species code 320 (category LF)

Scientific name: [Hemitripterus americanus](#)

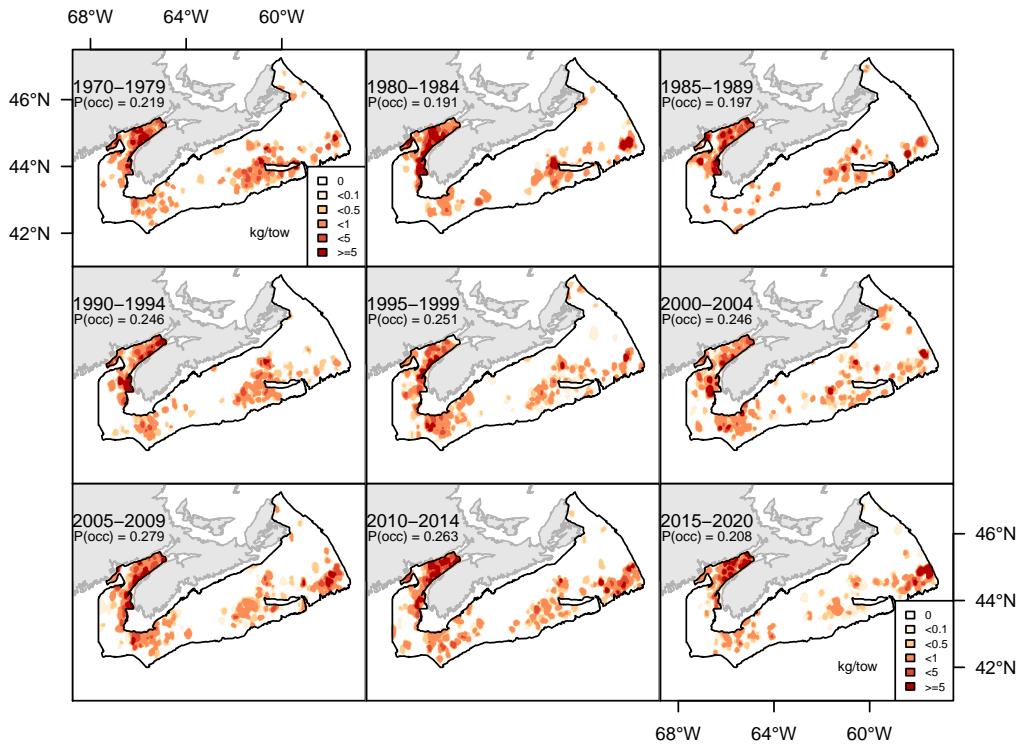


Figure 7.17A. Inverse distance weighted distribution of catch biomass (kg/tow) for Sea raven.

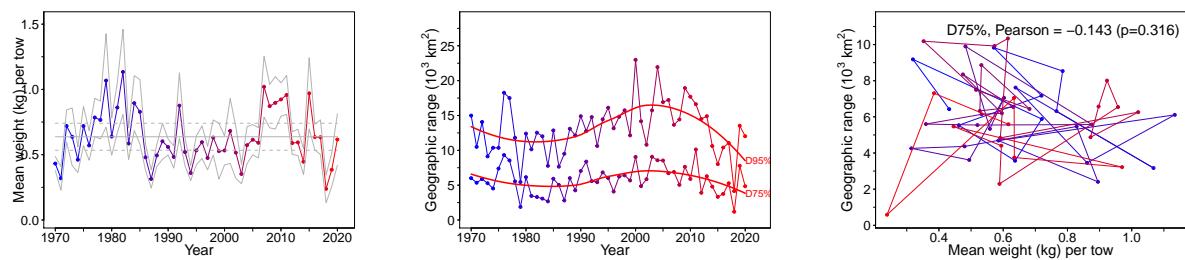


Figure 7.17B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Sea raven.

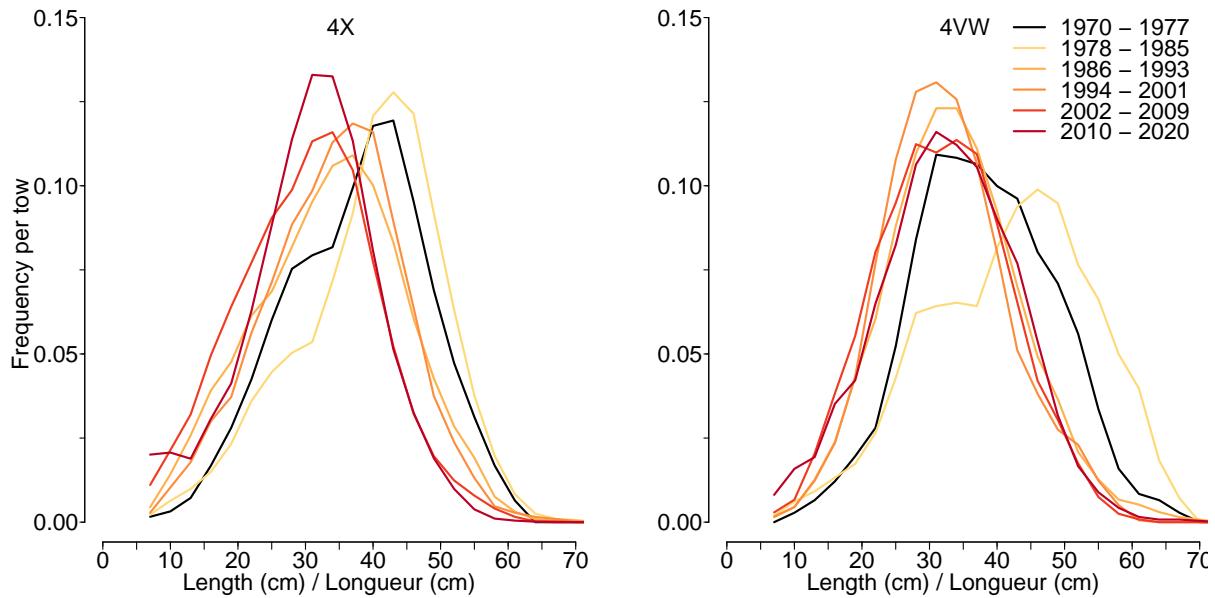


Figure 7.17C. Length frequency distribution in NAFO units 4X and 4VW for Sea raven.

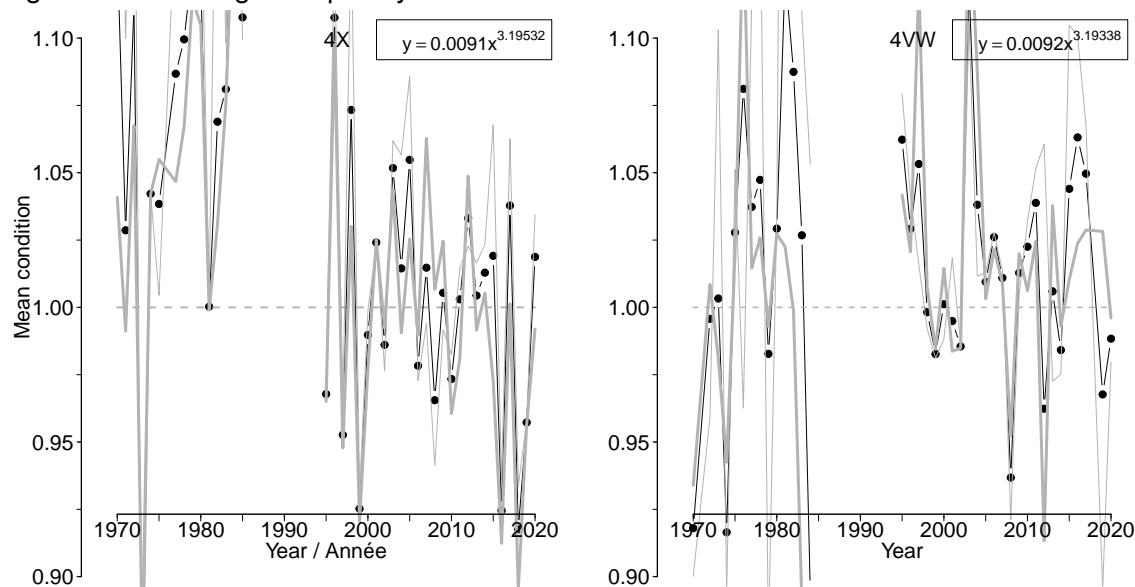


Figure 7.17D. Average fish condition in NAFO units 4X and 4VW for Sea raven.

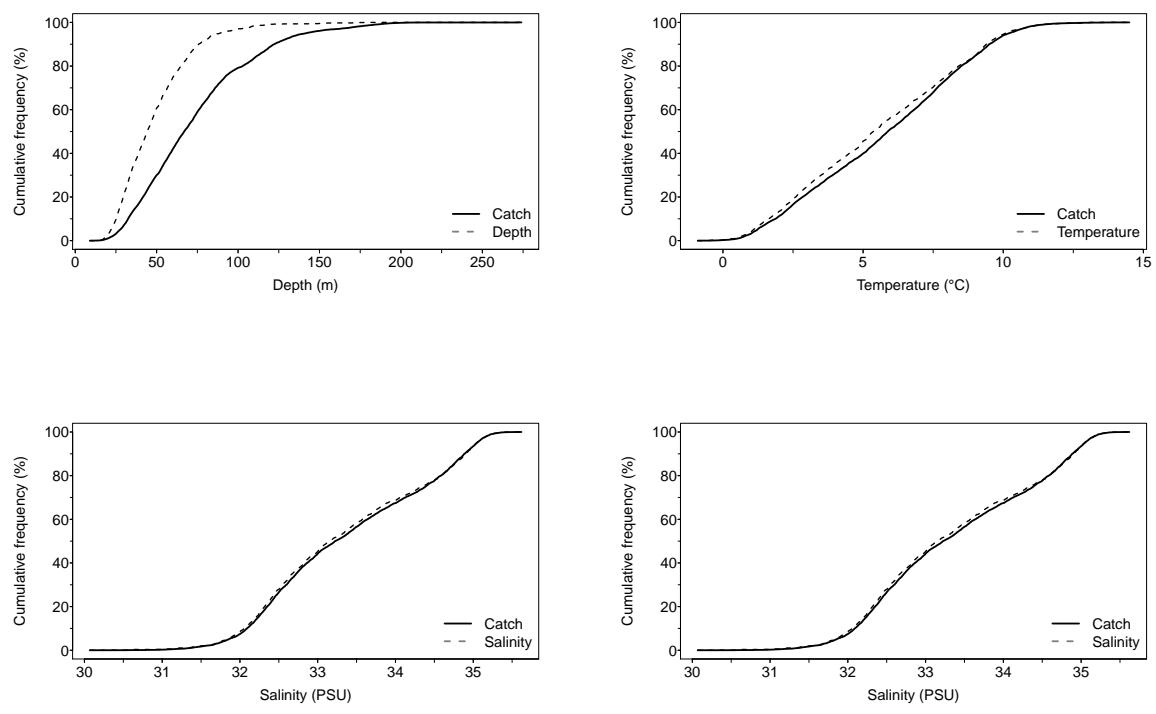


Figure 7.17E. Catch distribution by depth, temperature and salinity of Sea raven.

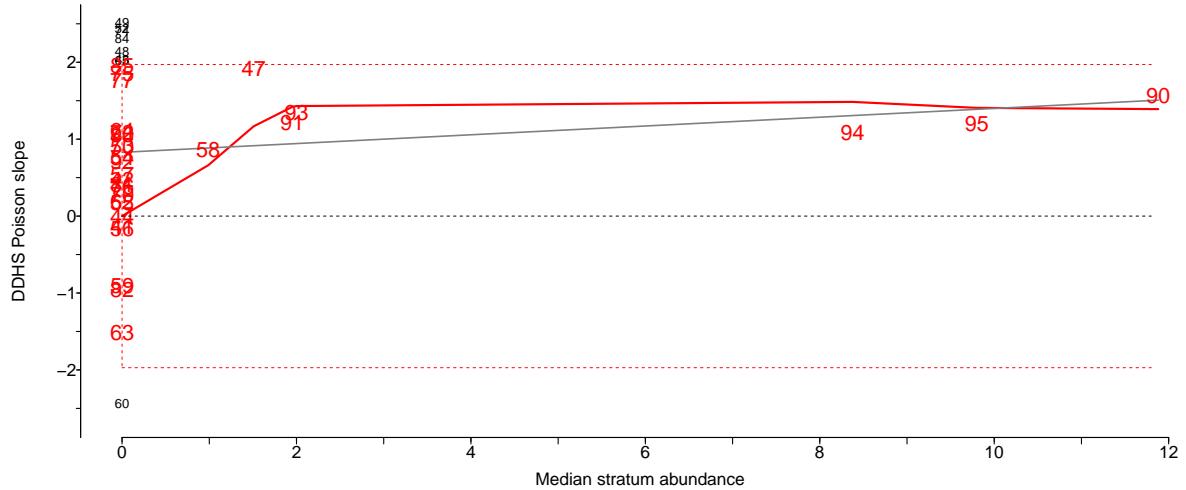


Figure 7.17F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Sea raven.

## 7.18 Alligatorfish (Poisson-alligator atlantique) - species code 340 (category LF)

Scientific name: [Aspidophoroides monopterygius](#)

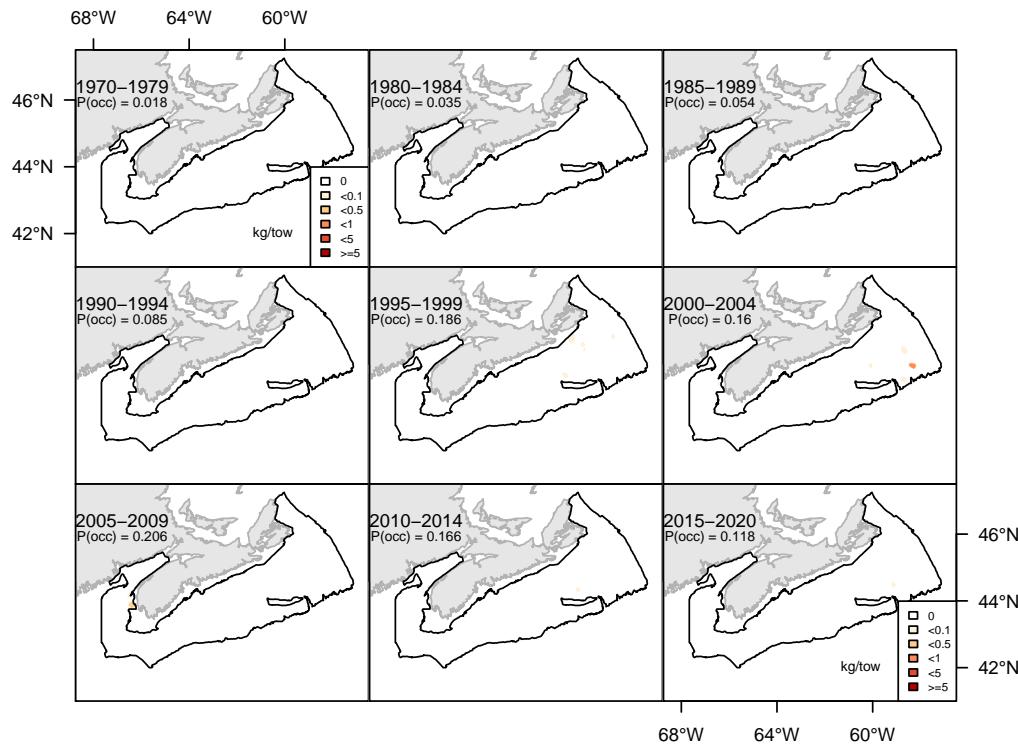


Figure 7.18A. Inverse distance weighted distribution of catch biomass (kg/tow) for Alligatorfish.

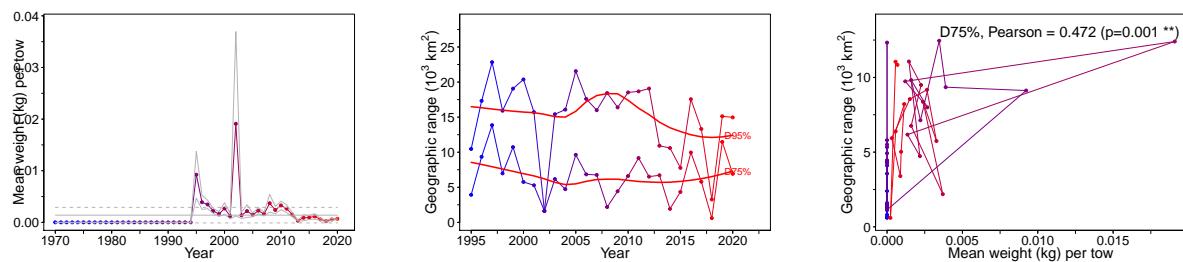


Figure 7.18B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Alligatorfish.

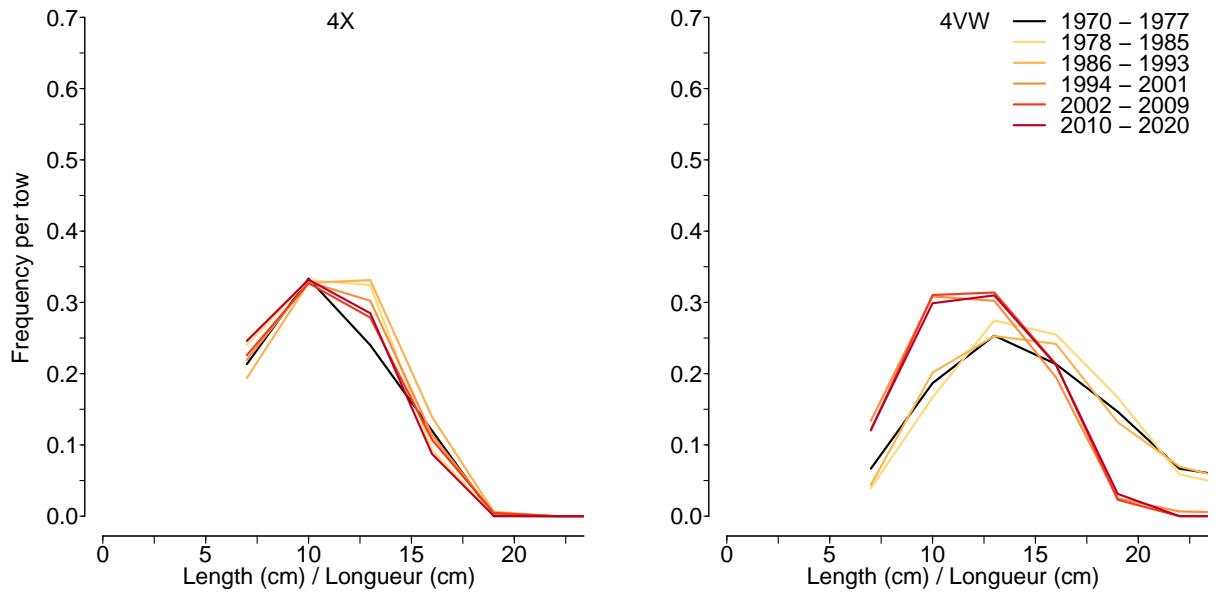


Figure 7.18C. Length frequency distribution in NAFO units 4X and 4VW for Alligatorfish.

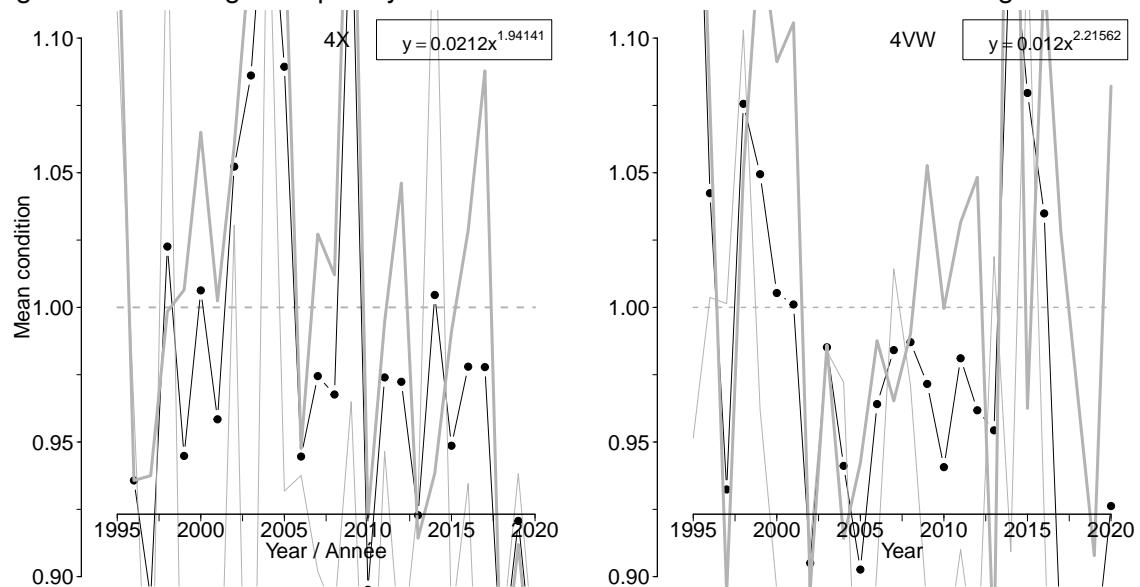


Figure 7.18D. Average fish condition in NAFO units 4X and 4VW for Alligatorfish.

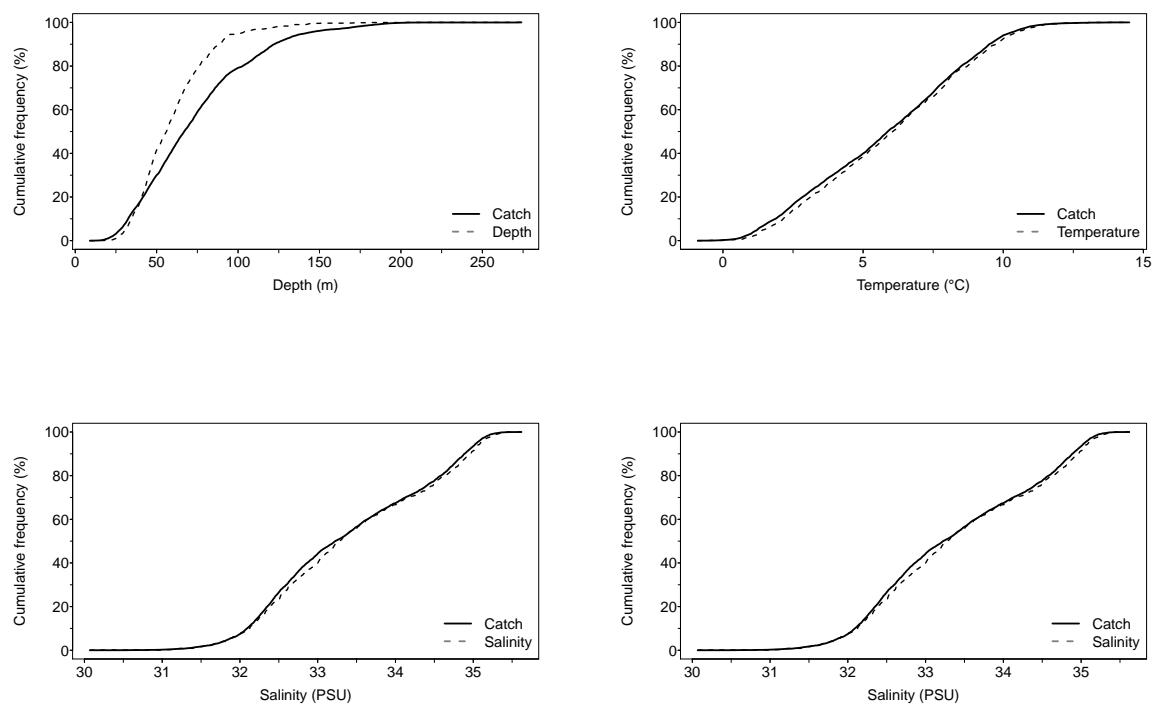


Figure 7.18E. Catch distribution by depth, temperature and salinity of Alligatorfish.

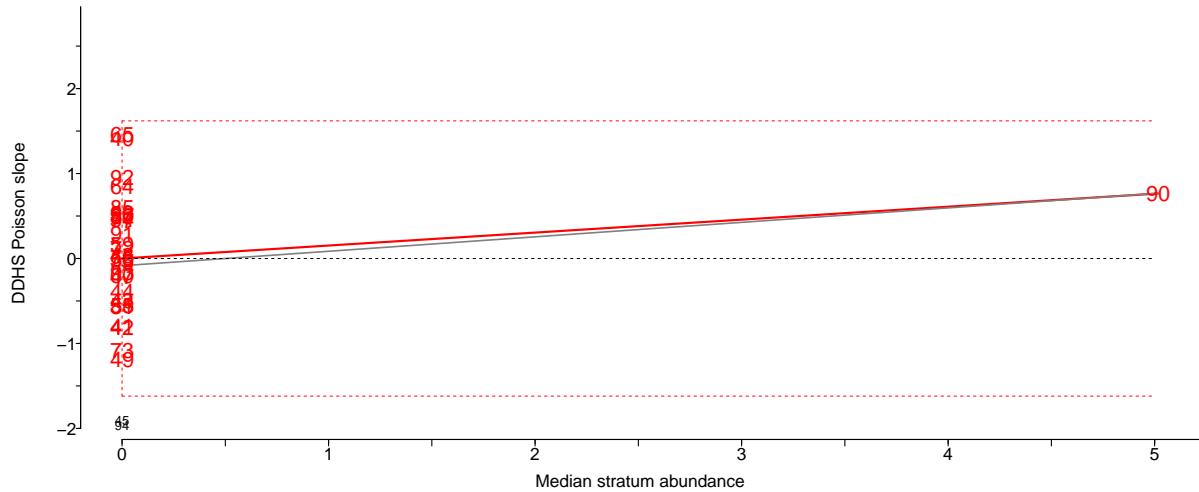


Figure 7.18F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Alligatorfish.

## 7.19 Monkfish (Baudroie d'Amérique) - species code 400 (category LF)

Scientific name: [Lophius americanus](#)

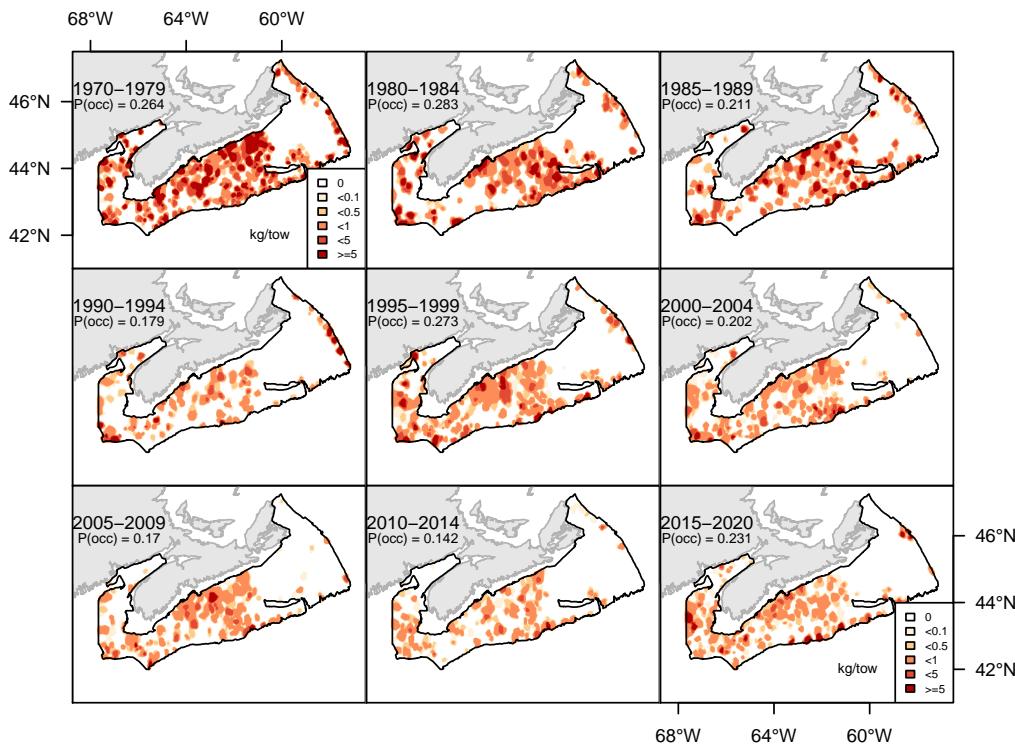


Figure 7.19A. Inverse distance weighted distribution of catch biomass (kg/tow) for Monkfish.

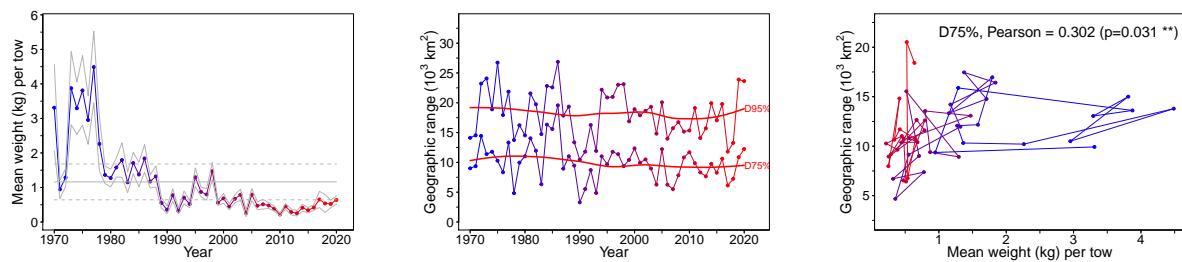


Figure 7.19B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Monkfish.

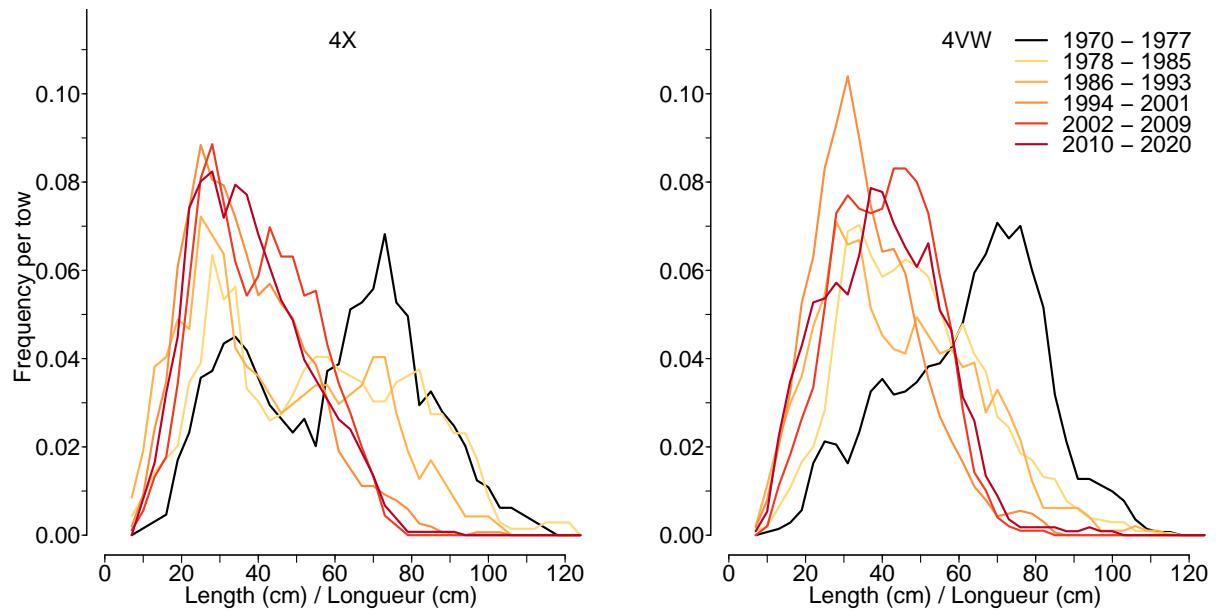


Figure 7.19C. Length frequency distribution in NAFO units 4X and 4VW for Monkfish.

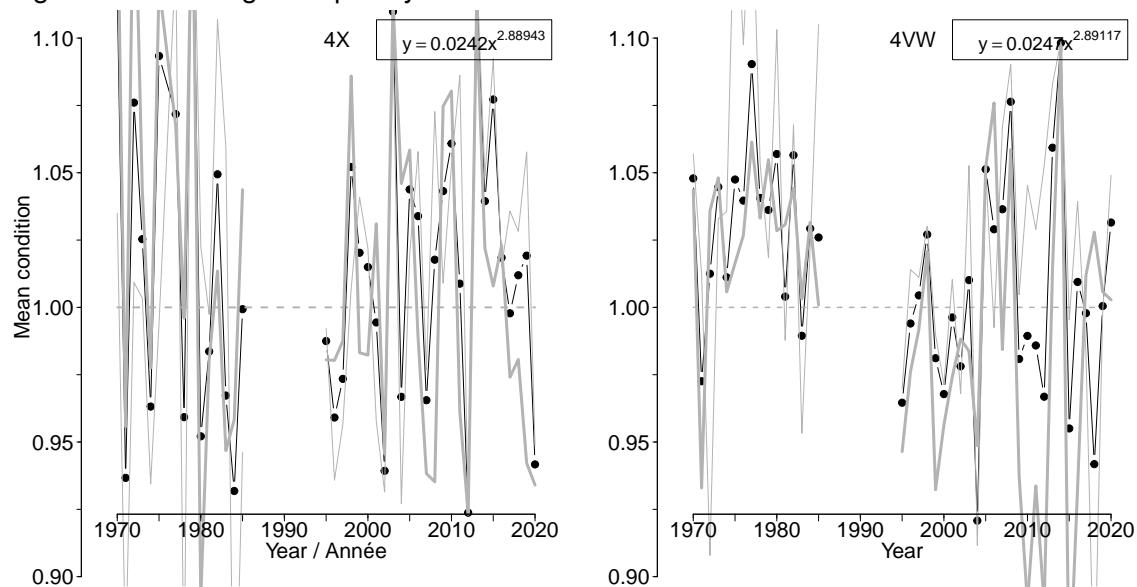


Figure 7.19D. Average fish condition in NAFO units 4X and 4VW for Monkfish.

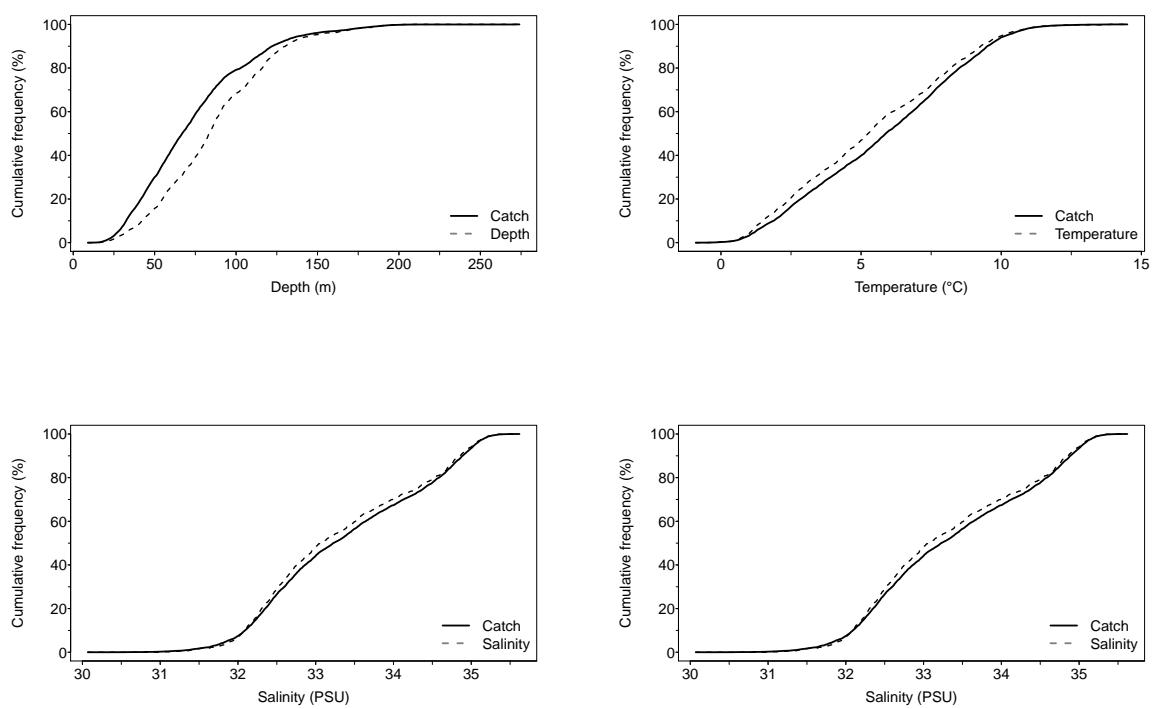


Figure 7.19E. Catch distribution by depth, temperature and salinity of Monkfish.

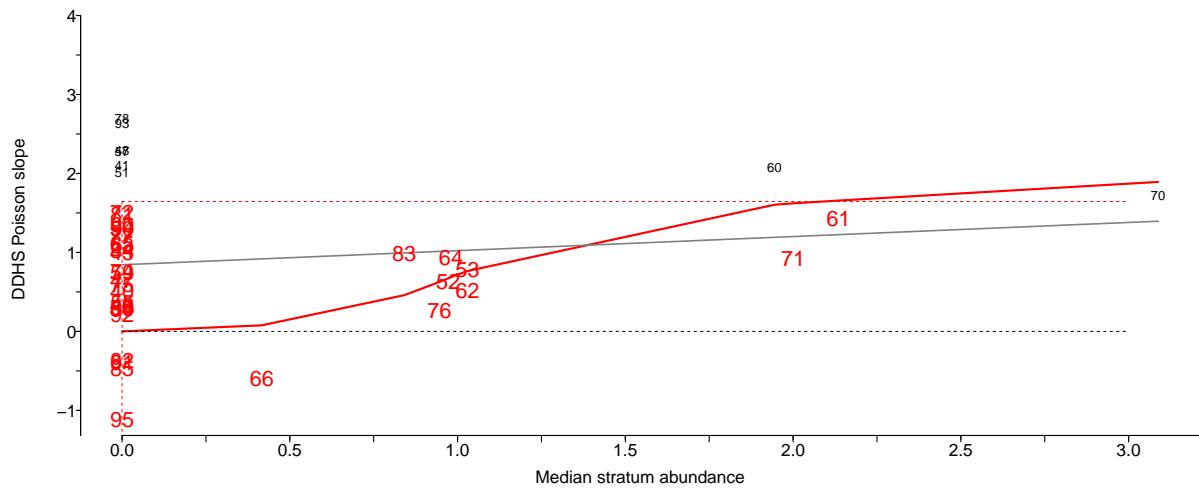


Figure 7.19F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Monkfish.

## 7.20 Ocean pout (Loquette d'Amérique) - species code 640 (category LF)

Scientific name: [Zoarces americanus](#)

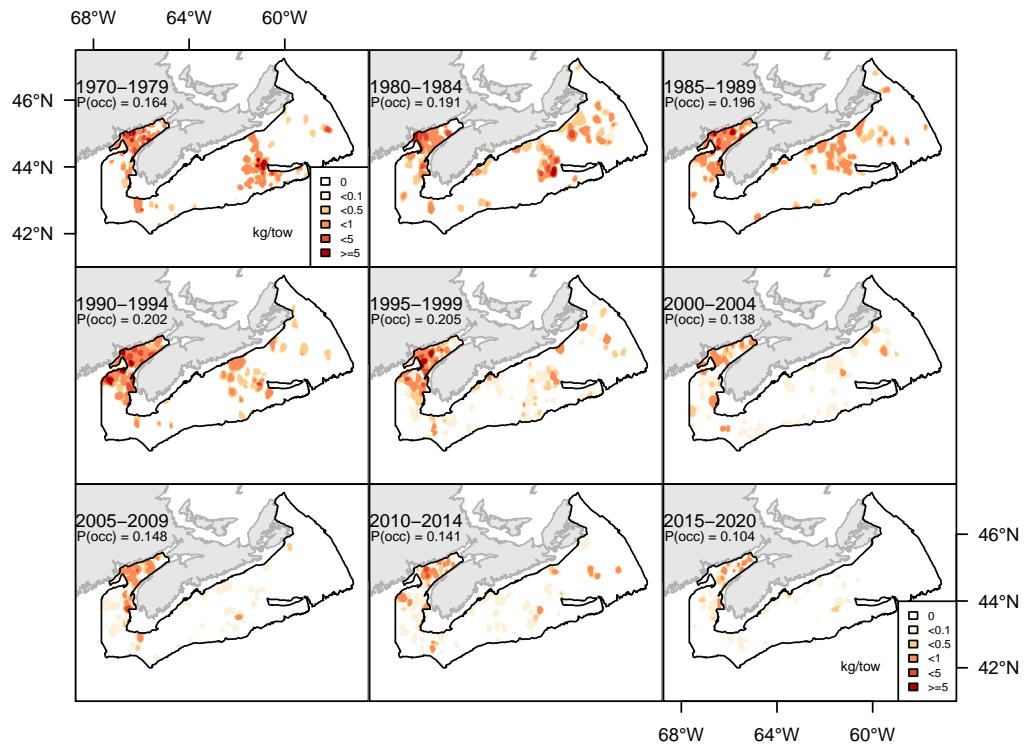


Figure 7.20A. Inverse distance weighted distribution of catch biomass (kg/tow) for Ocean pout.

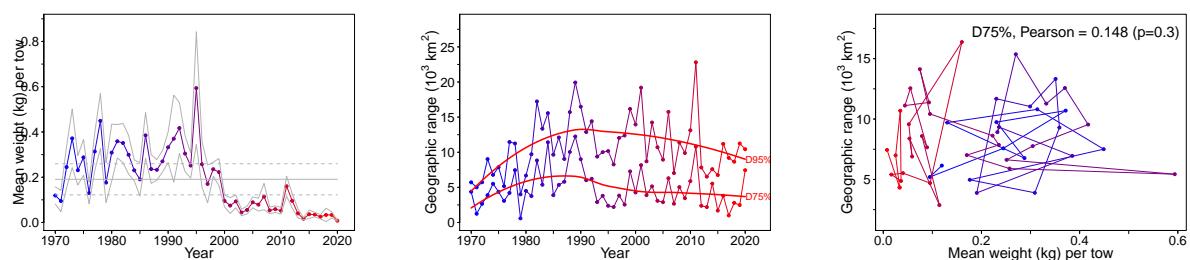


Figure 7.20B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Ocean pout.

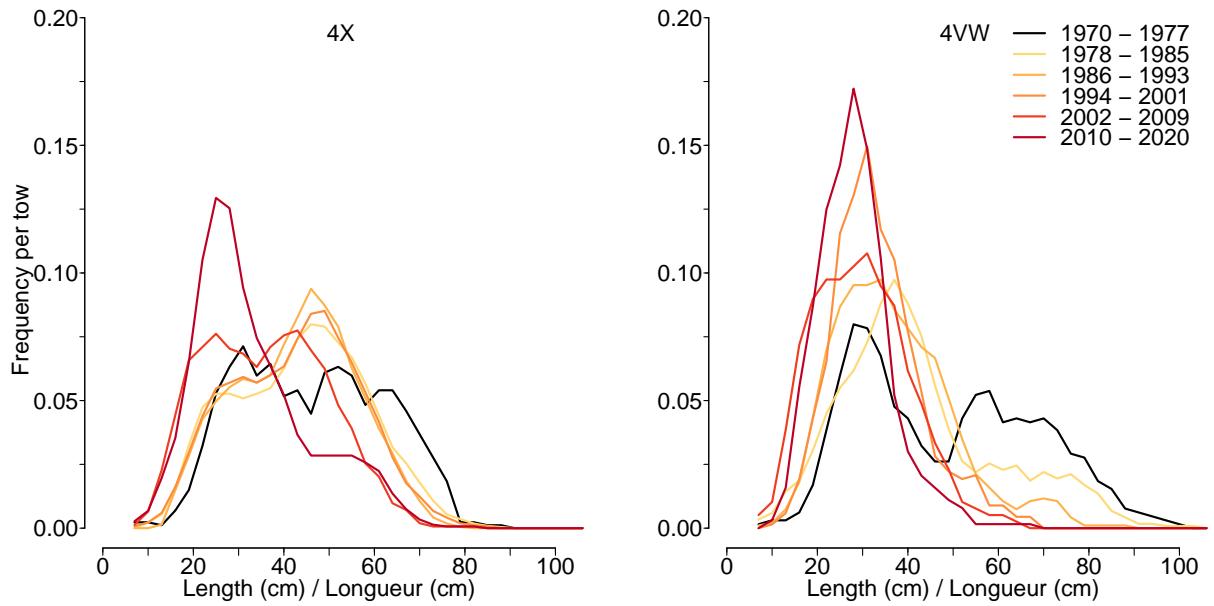


Figure 7.20C. Length frequency distribution in NAFO units 4X and 4VW for Ocean pout.

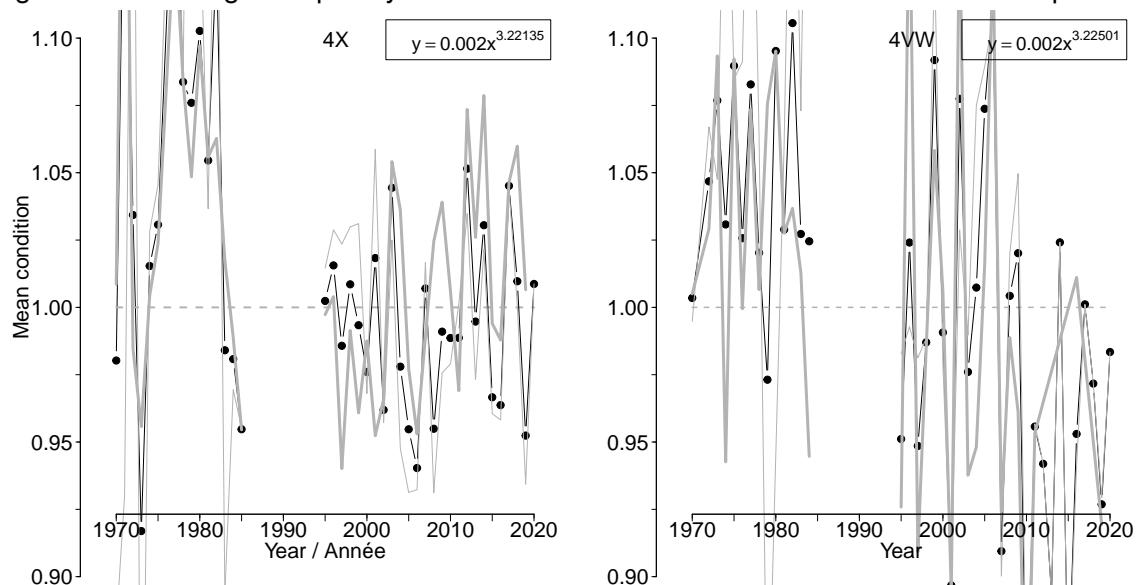


Figure 7.20D. Average fish condition in NAFO units 4X and 4VW for Ocean pout.

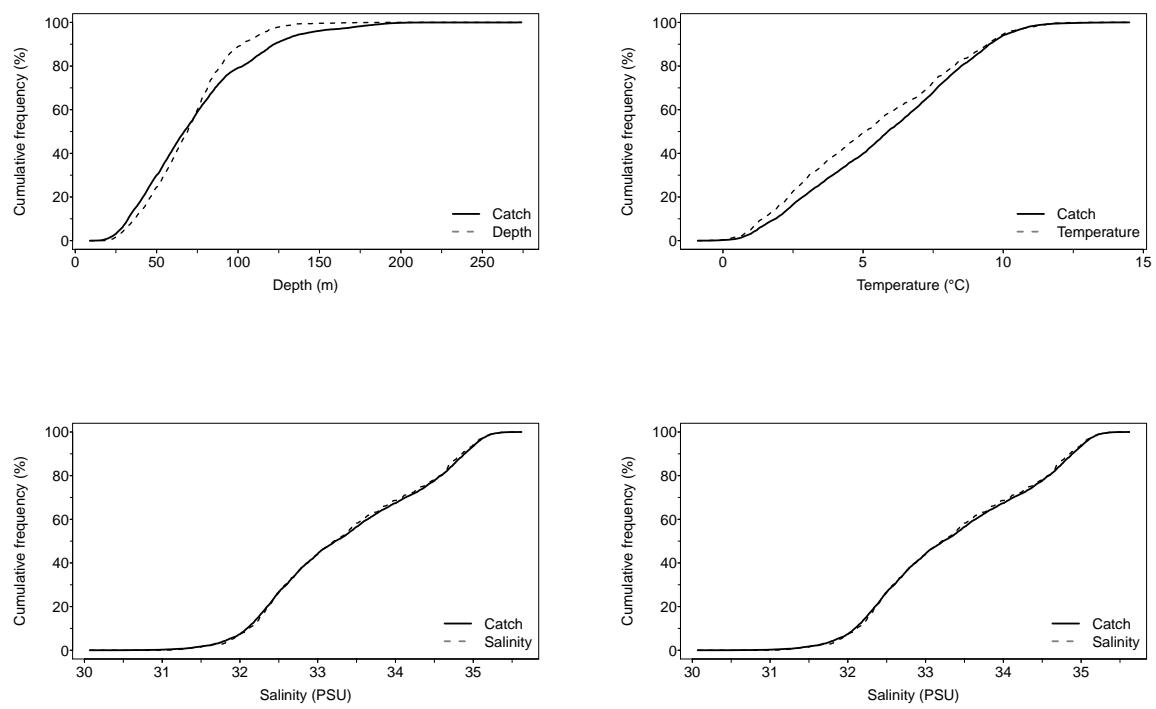


Figure 7.20E. Catch distribution by depth, temperature and salinity of Ocean pout.

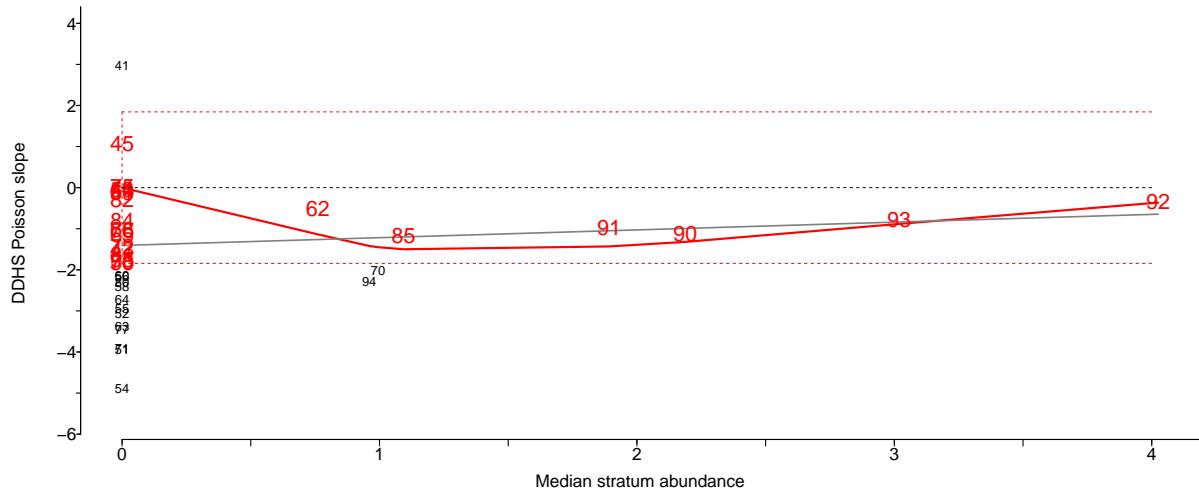


Figure 7.20F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Ocean pout.

## 7.21 Thorny skate (Raie épineuse) - species code 201 (category LF)

Scientific name: [Amblyraja radiata](#)

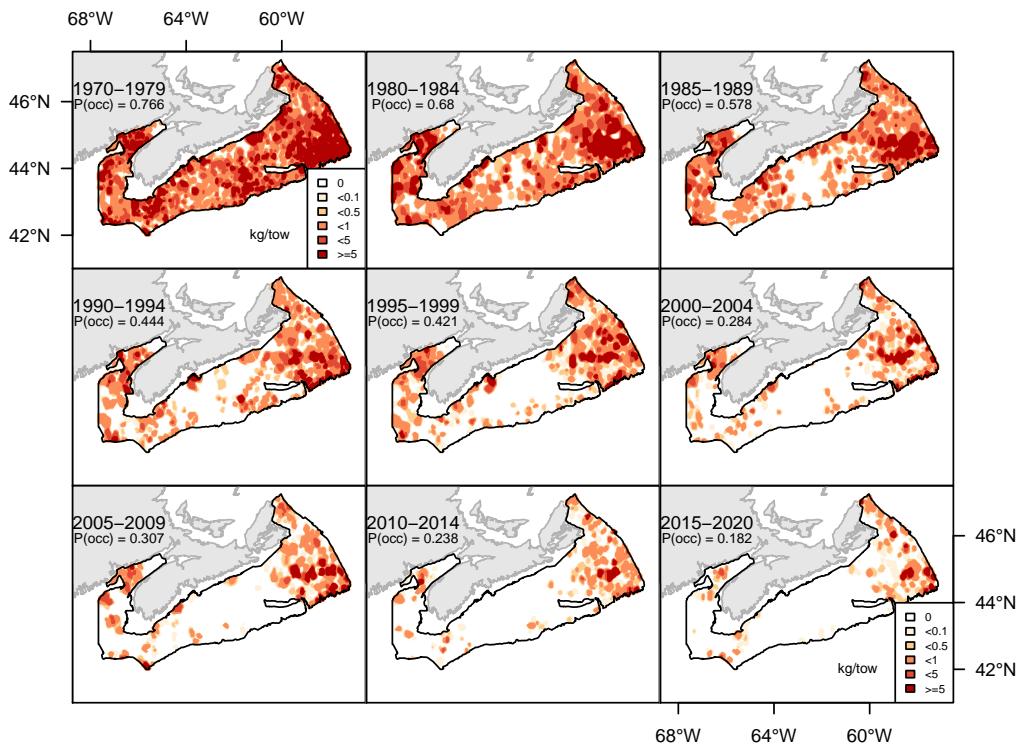


Figure 7.21A. Inverse distance weighted distribution of catch biomass (kg/tow) for Thorny skate.

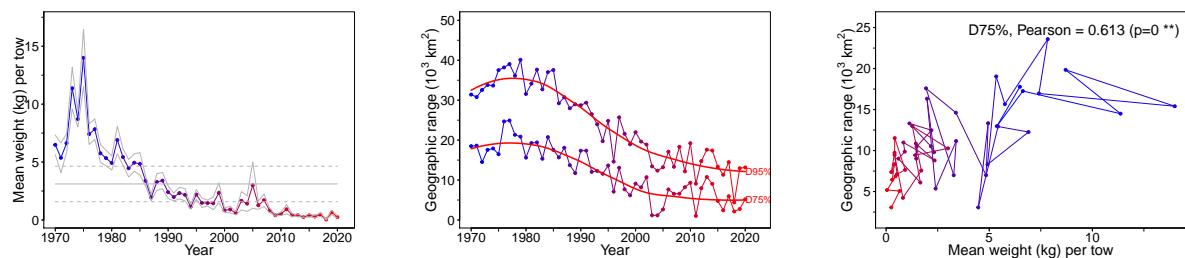


Figure 7.21B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Thorny skate.

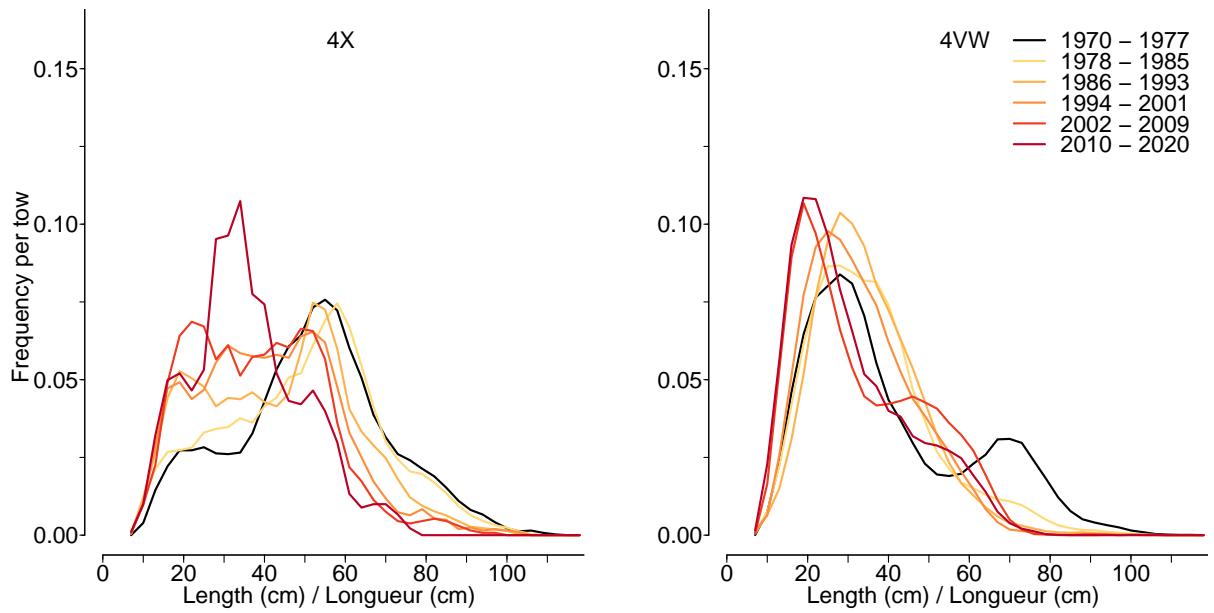


Figure 7.21C. Length frequency distribution in NAFO units 4X and 4VW for Thorny skate.

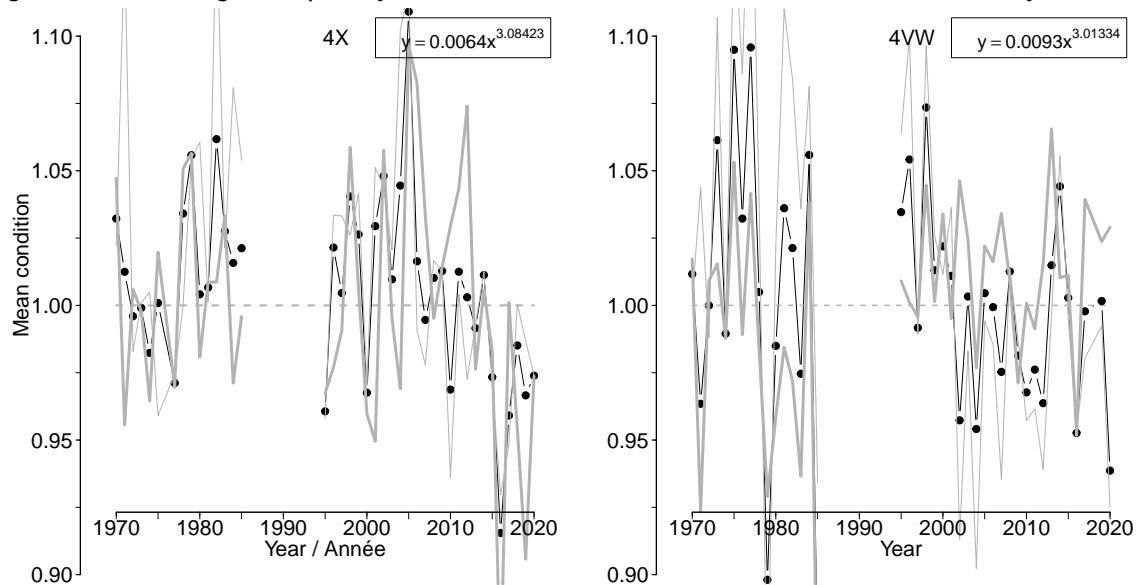


Figure 7.21D. Average fish condition in NAFO units 4X and 4VW for Thorny skate.

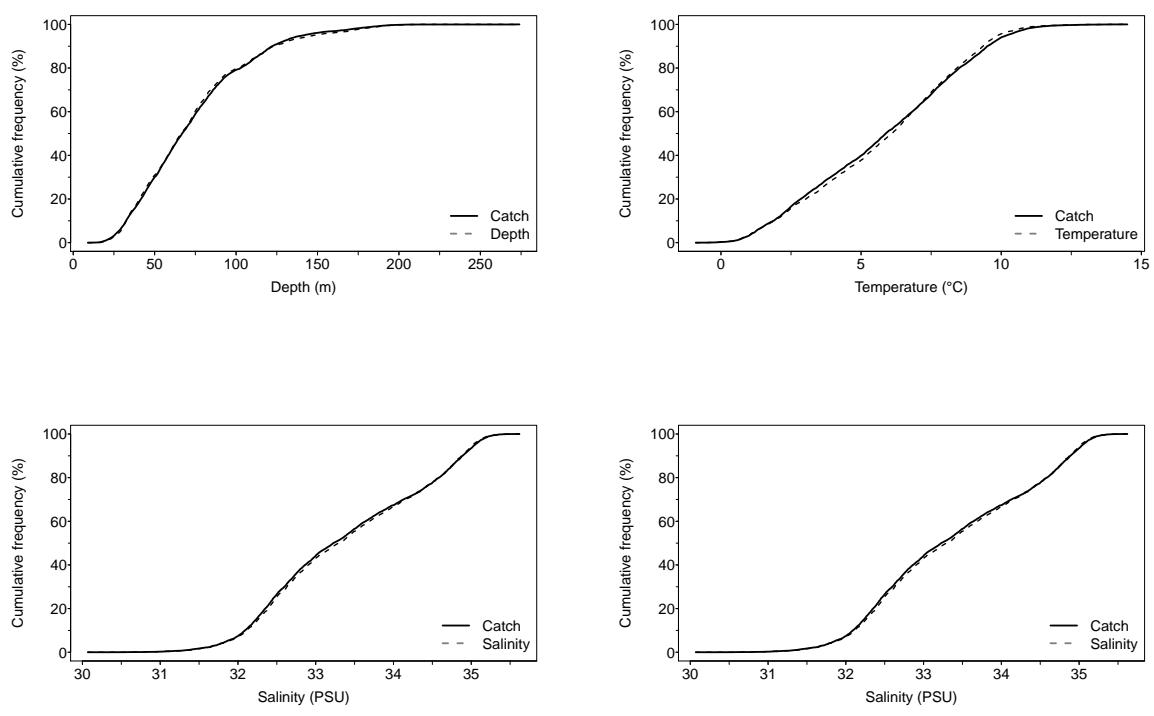


Figure 7.21E. Catch distribution by depth, temperature and salinity of Thorny skate.

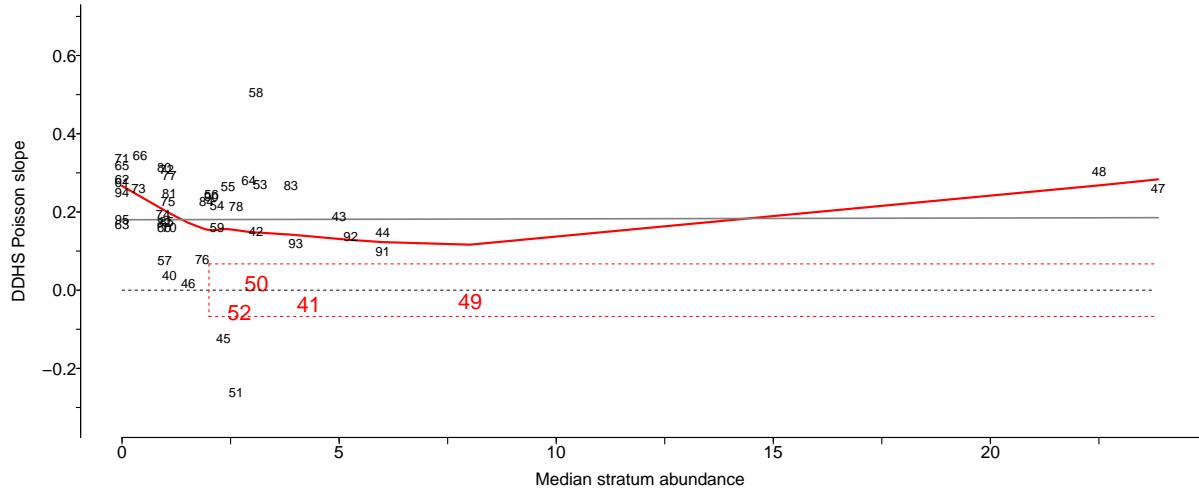


Figure 7.21F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Thorny skate.

## 7.22 Smooth skate (Raie lisse) - species code 202 (category LF)

Scientific name: [Malacoraja senta](#)

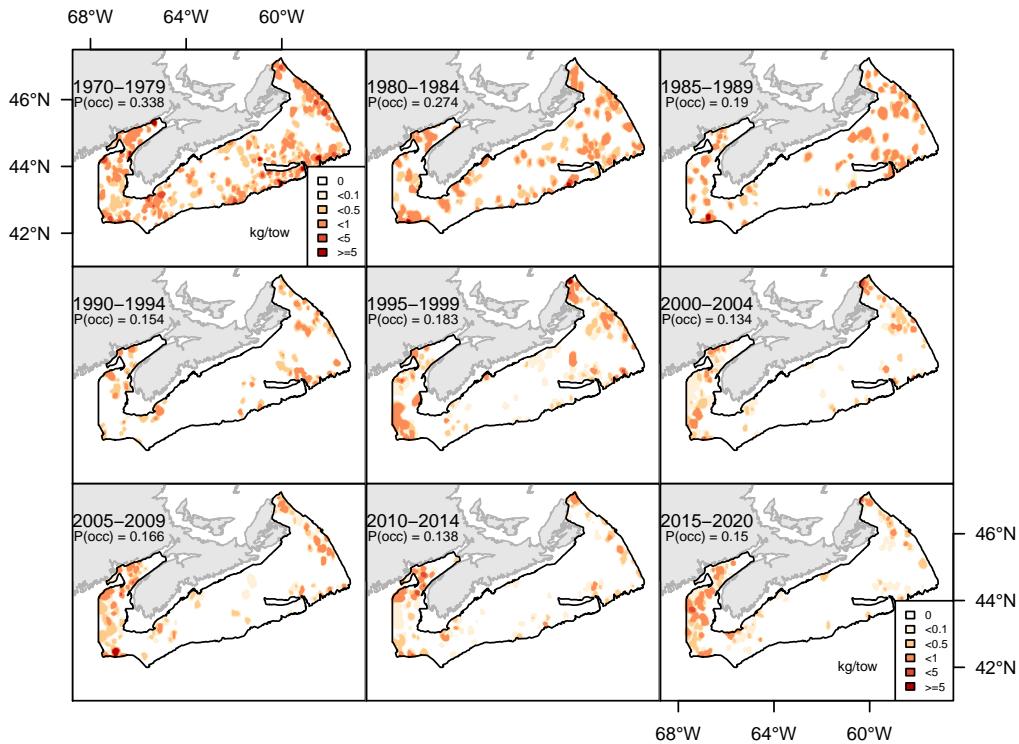


Figure 7.22A. Inverse distance weighted distribution of catch biomass (kg/tow) for Smooth skate.

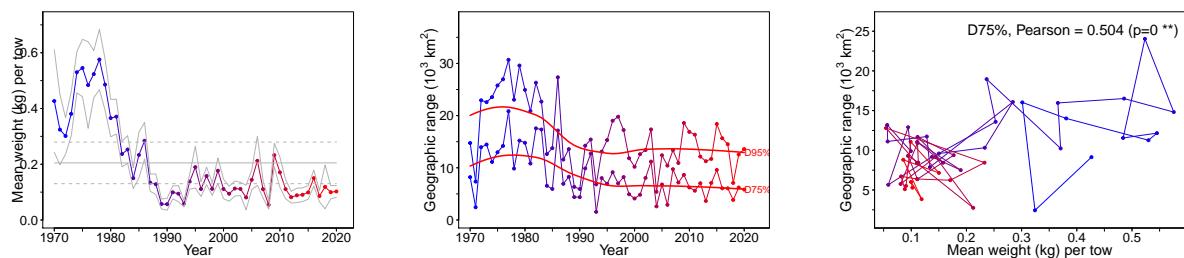


Figure 7.22B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Smooth skate.

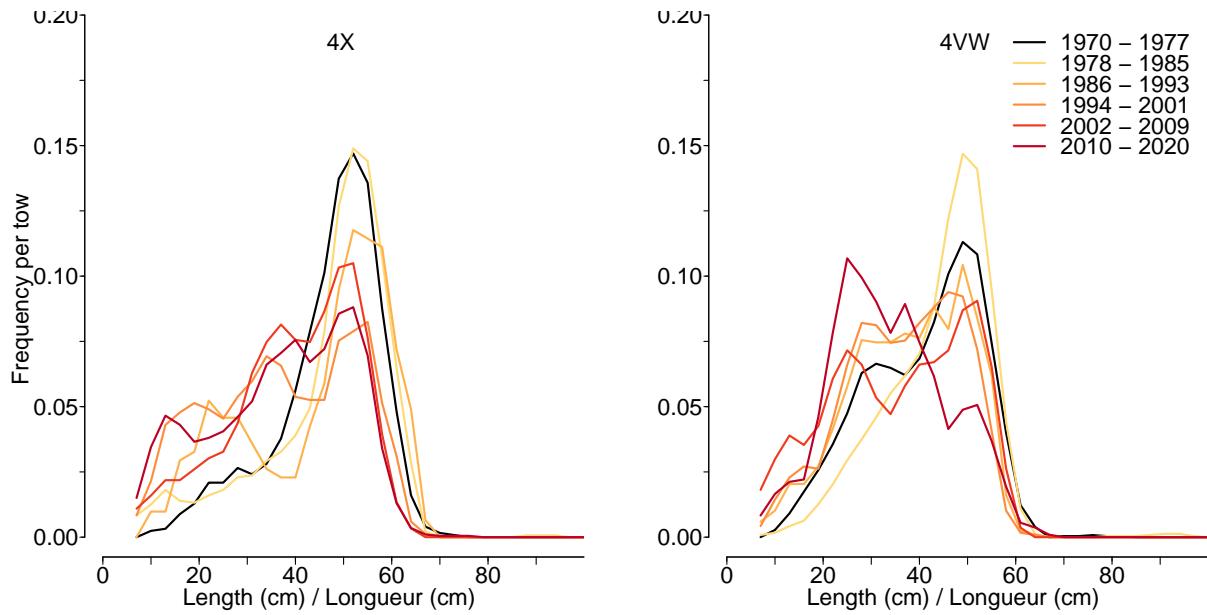


Figure 7.22C. Length frequency distribution in NAFO units 4X and 4VW for Smooth skate.

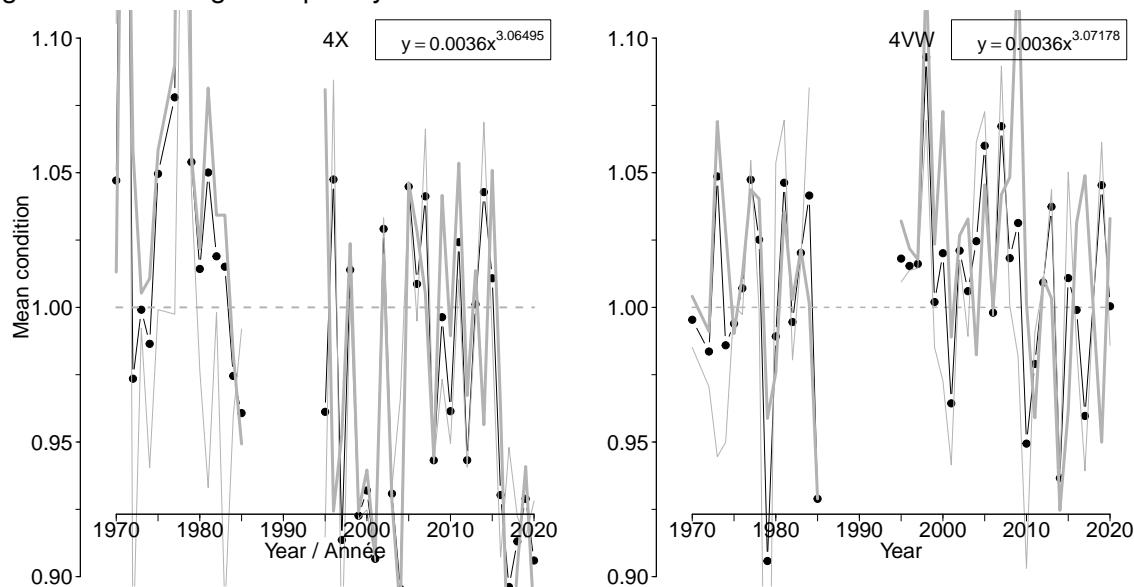


Figure 7.22D. Average fish condition in NAFO units 4X and 4VW for Smooth skate.

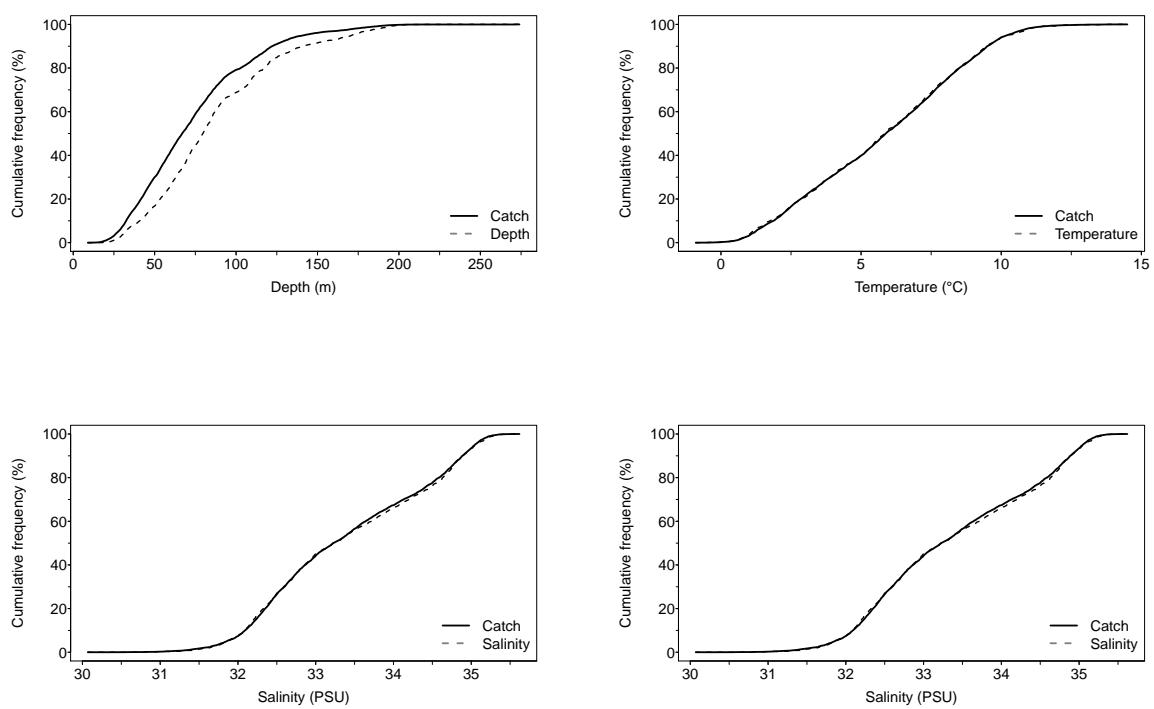


Figure 7.22E. Catch distribution by depth, temperature and salinity of Smooth skate.

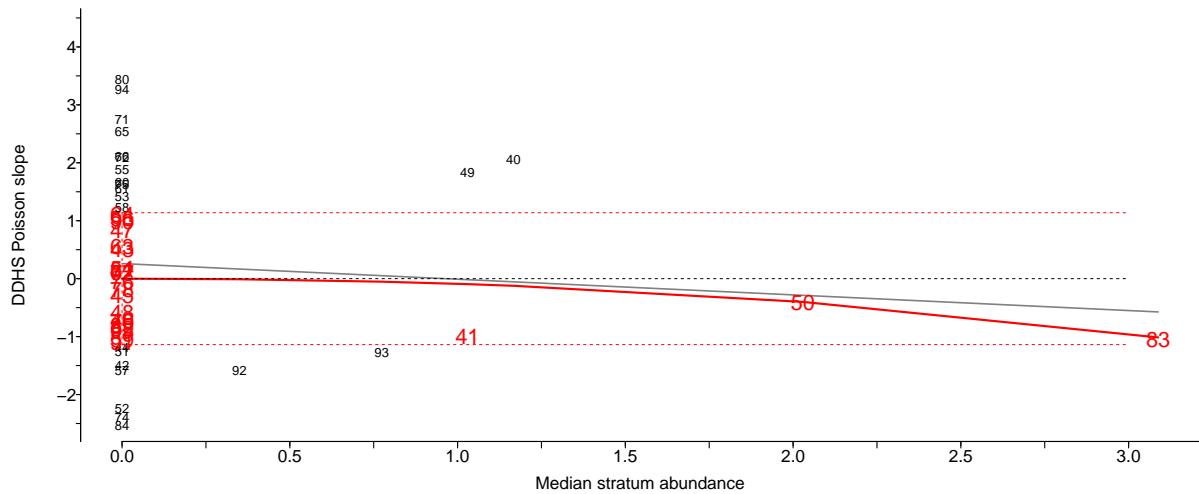


Figure 7.22F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Smooth skate.

## 7.23 Winter skate (Raie tachetée) - species code 204 (category LF)

Scientific name: [Leucoraja ocellata](#)

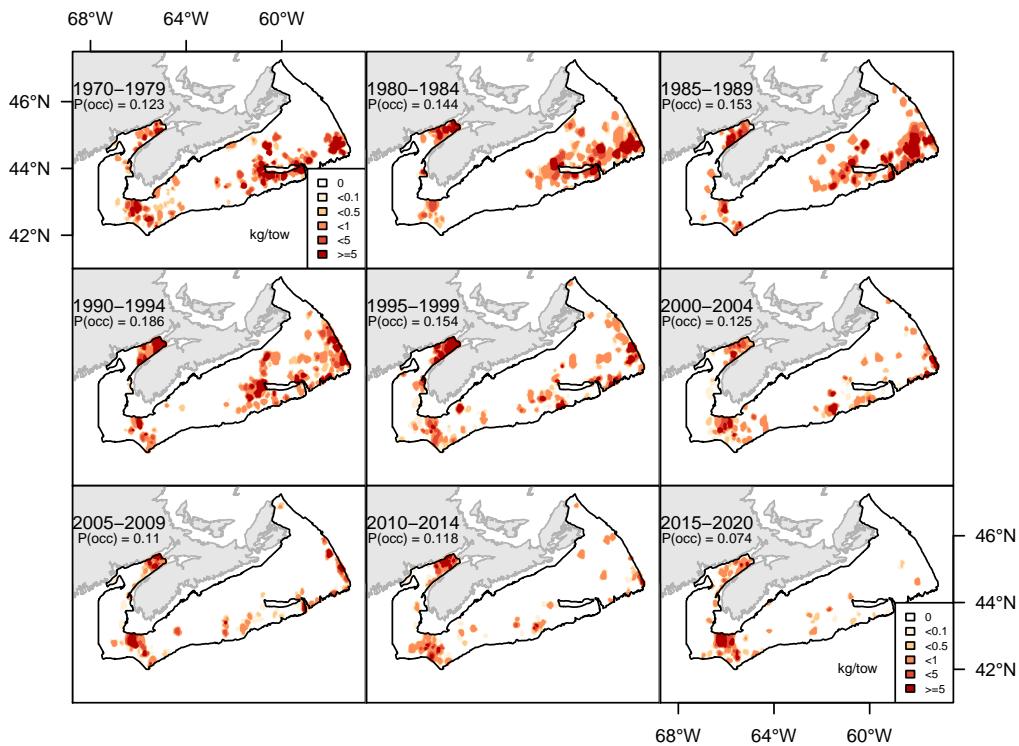


Figure 7.23A. Inverse distance weighted distribution of catch biomass (kg/tow) for Winter skate.

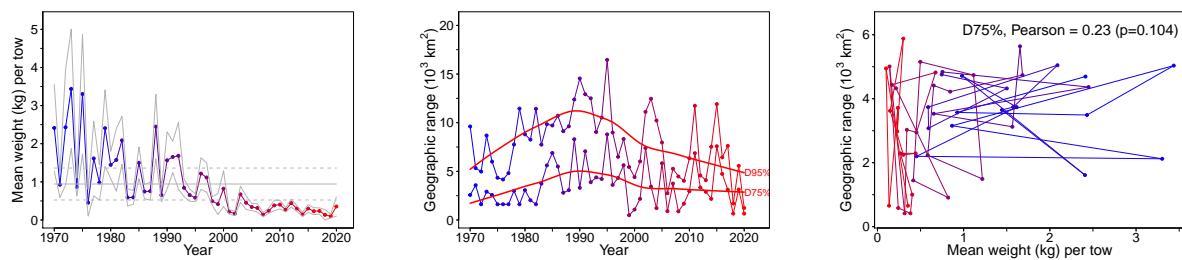


Figure 7.23B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Winter skate.

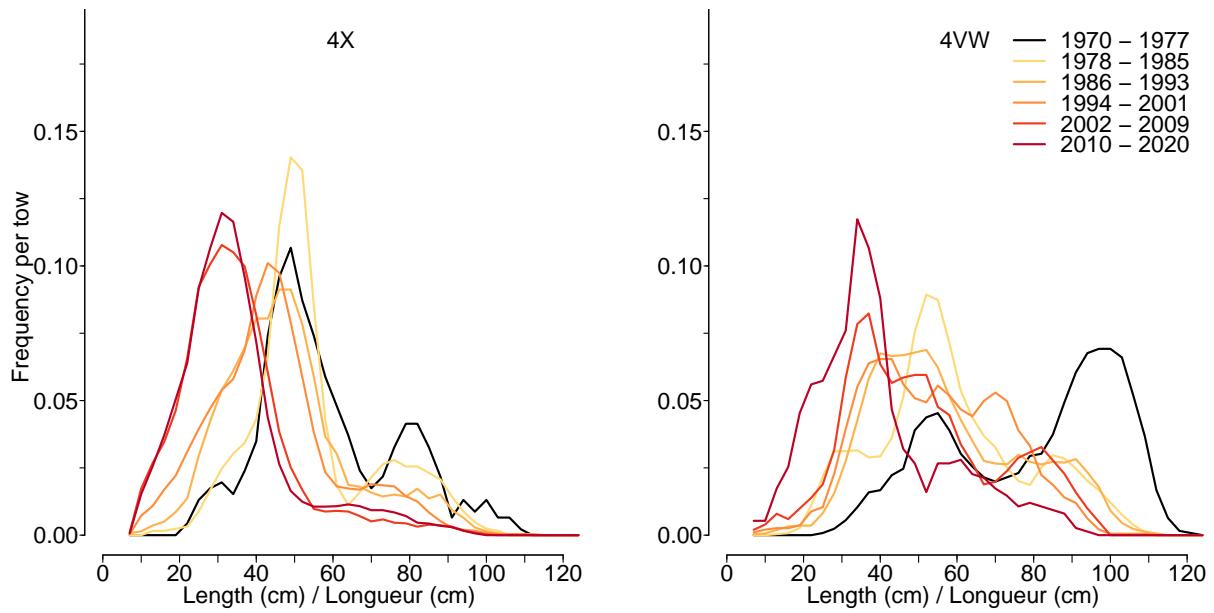


Figure 7.23C. Length frequency distribution in NAFO units 4X and 4VW for Winter skate.

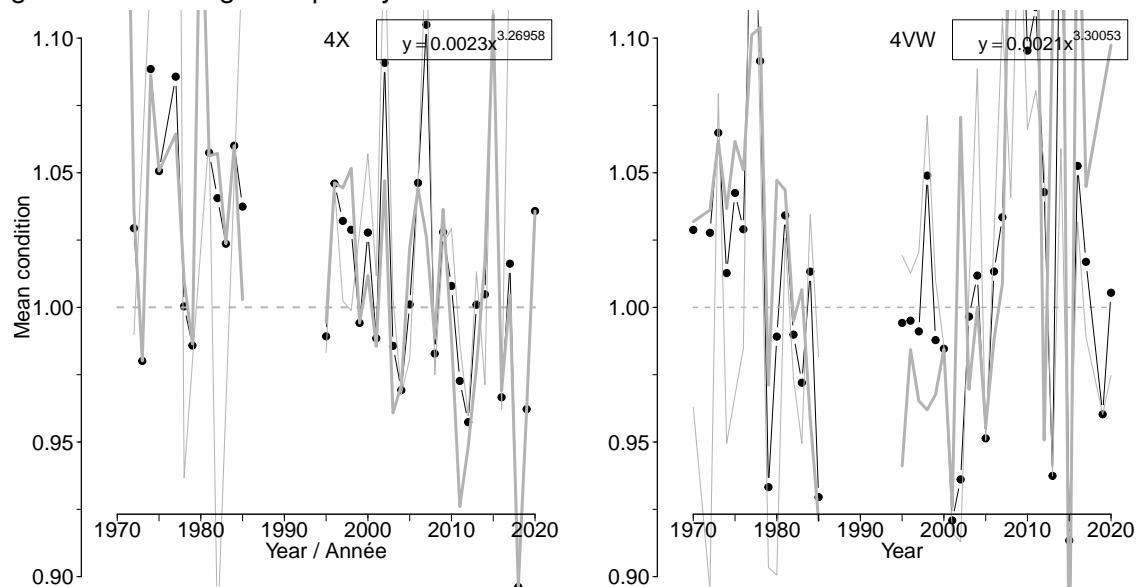


Figure 7.23D. Average fish condition in NAFO units 4X and 4VW for Winter skate.

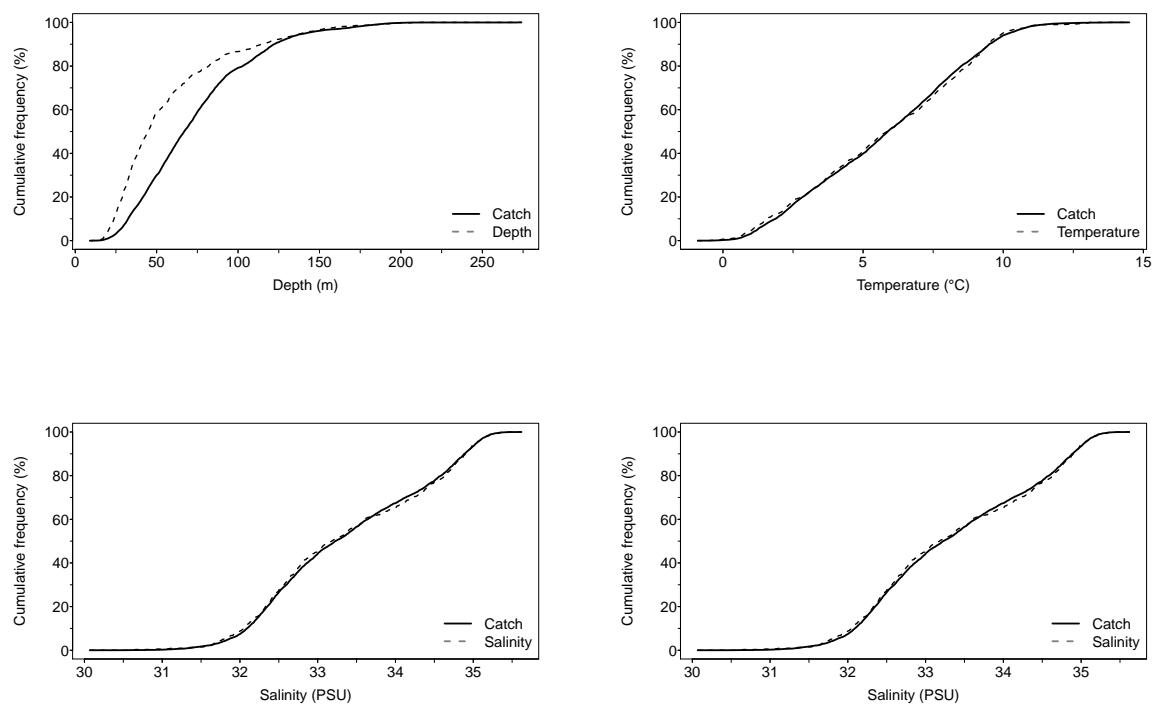


Figure 7.23E. Catch distribution by depth, temperature and salinity of Winter skate.

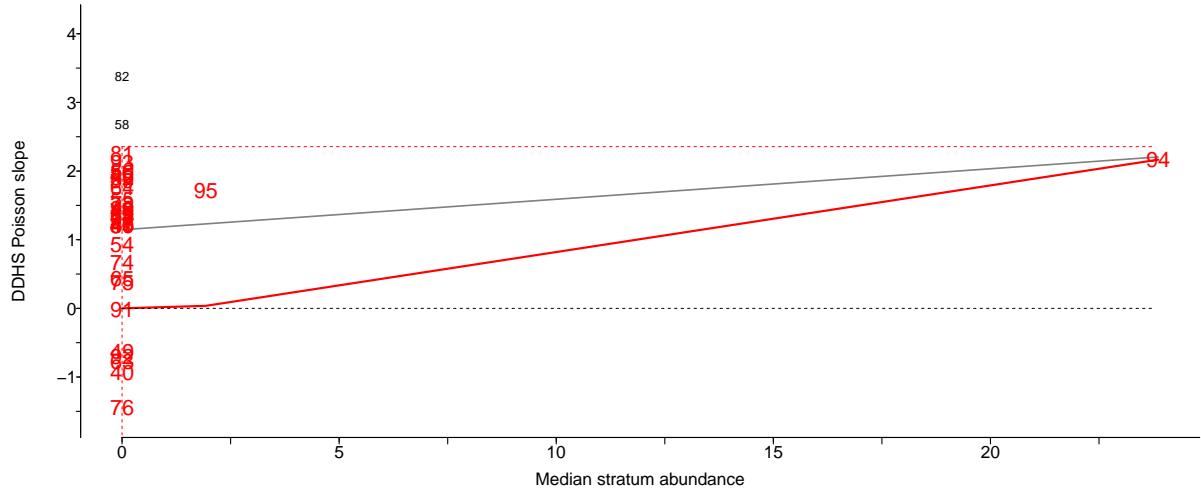


Figure 7.23F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Winter skate.

## 7.24 Picked dogfish (Aiguillat commun) - species code 220 (category LF)

Scientific name: [Squalus acanthias](#)

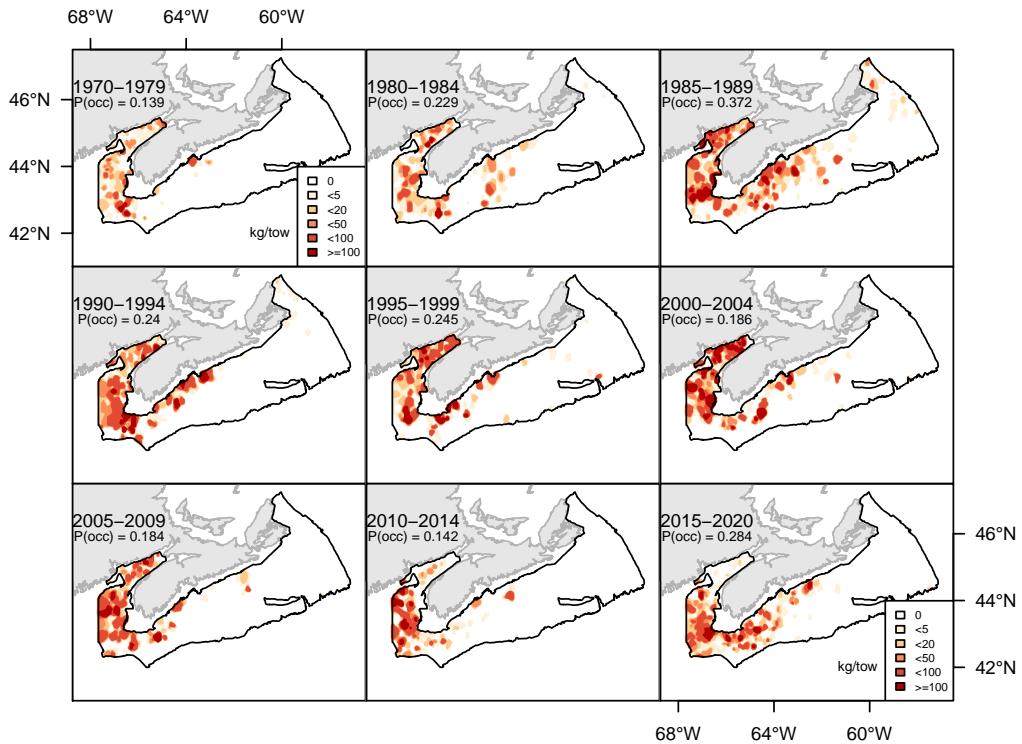


Figure 7.24A. Inverse distance weighted distribution of catch biomass (kg/tow) for Picked dogfish.

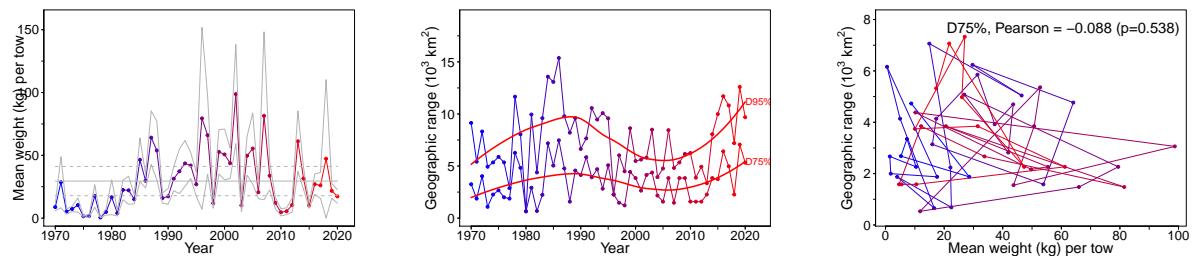


Figure 7.24B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Picked dogfish.

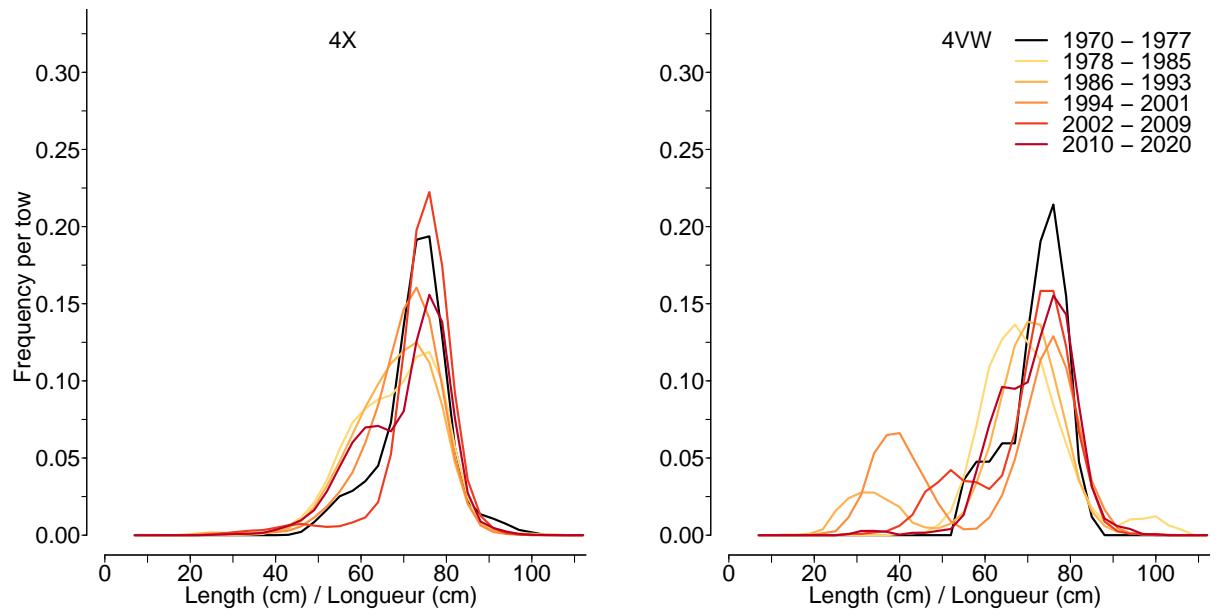


Figure 7.24C. Length frequency distribution in NAFO units 4X and 4VW for Picked dogfish.

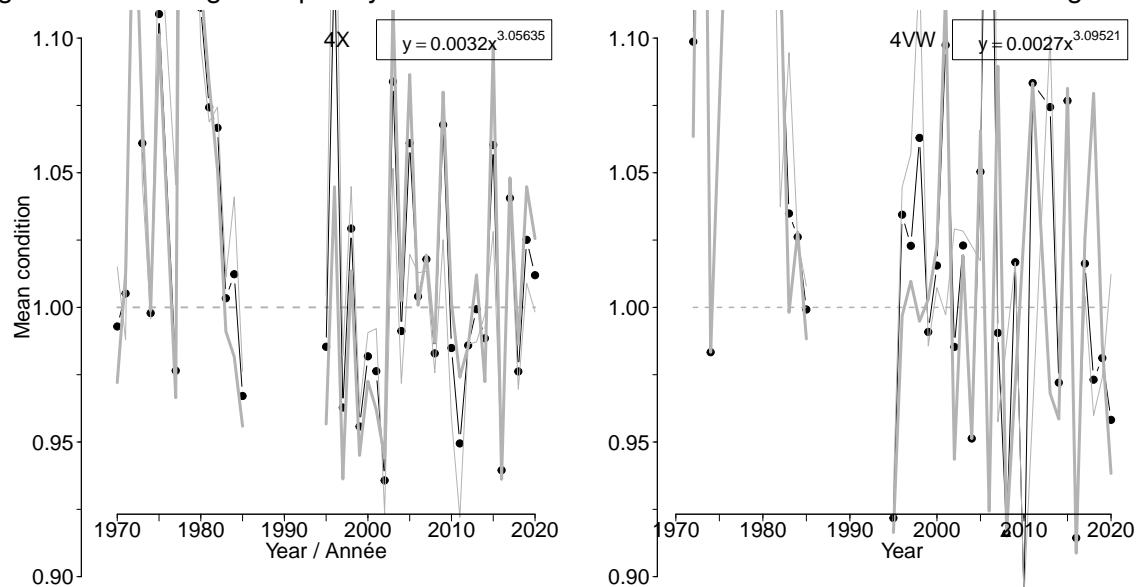


Figure 7.24D. Average fish condition in NAFO units 4X and 4VW for Picked dogfish.

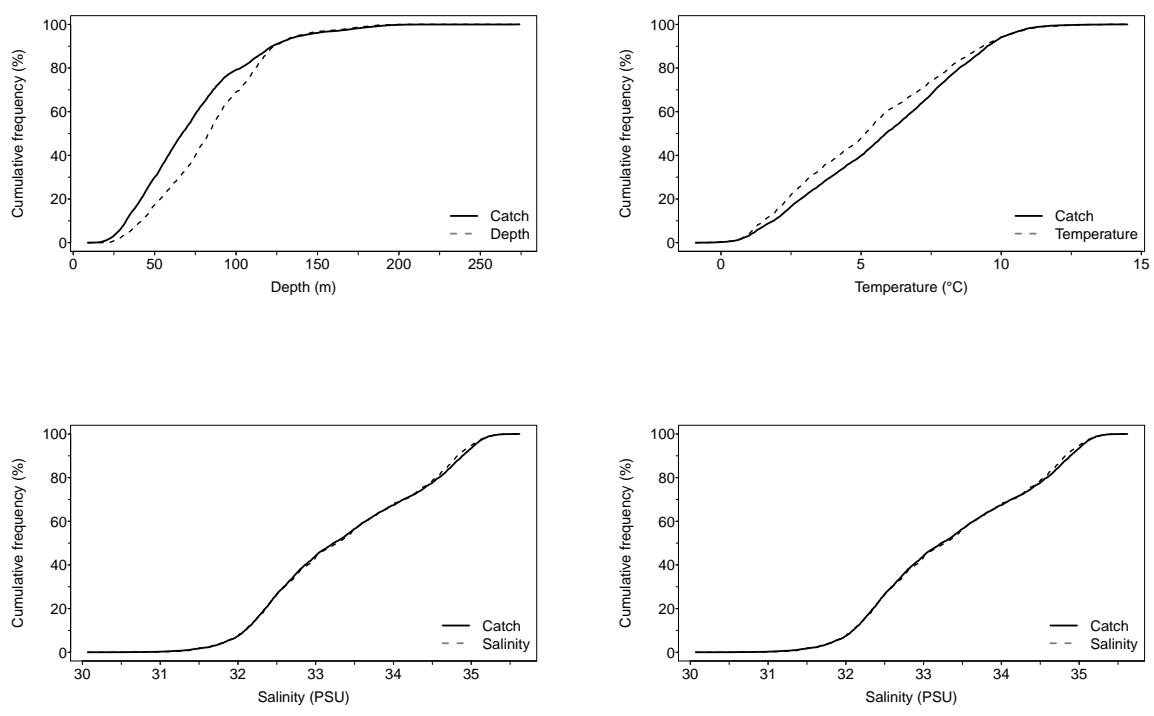


Figure 7.24E. Catch distribution by depth, temperature and salinity of Picked dogfish.

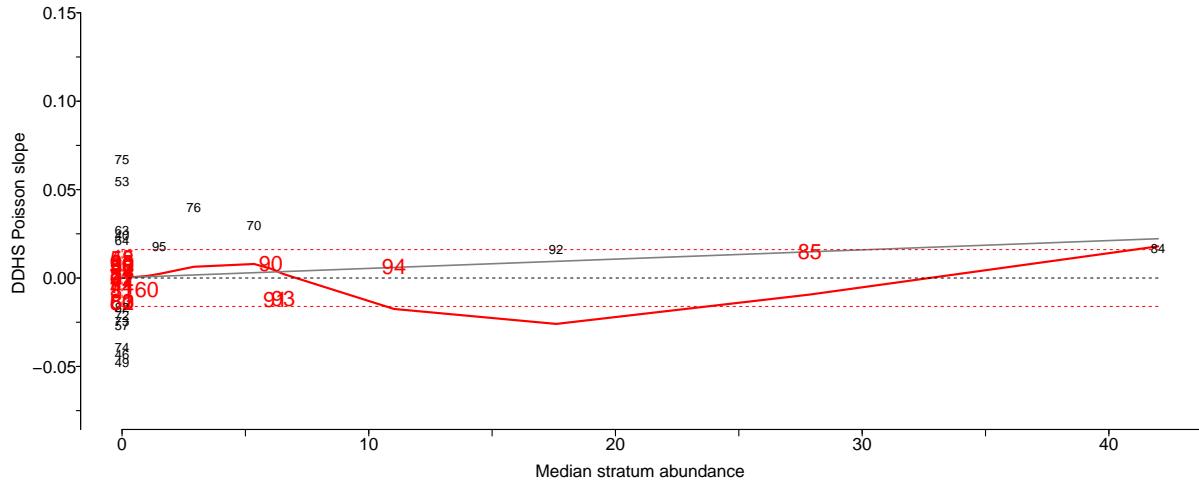


Figure 7.24F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Picked dogfish.

## 7.25 Northern shortfin squid (*Encornet rouge nordique*) - species code 4511 (category LF)

Scientific name: *Illex illecebrosus*

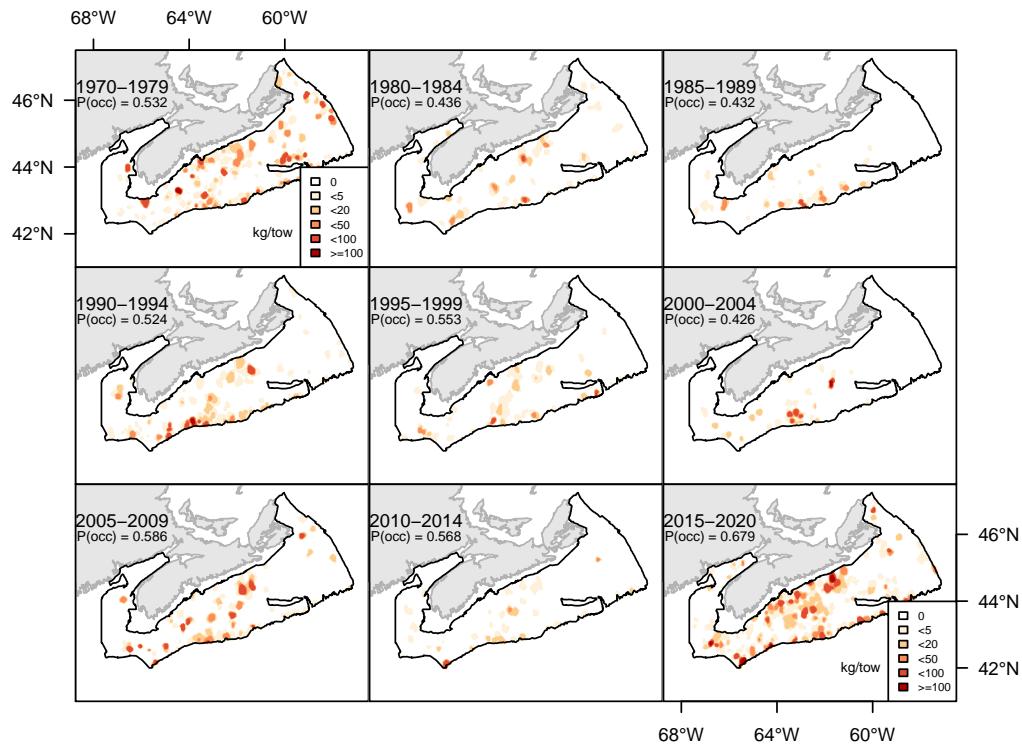


Figure 7.25A. Inverse distance weighted distribution of catch biomass (kg/tow) for Northern shortfin squid.

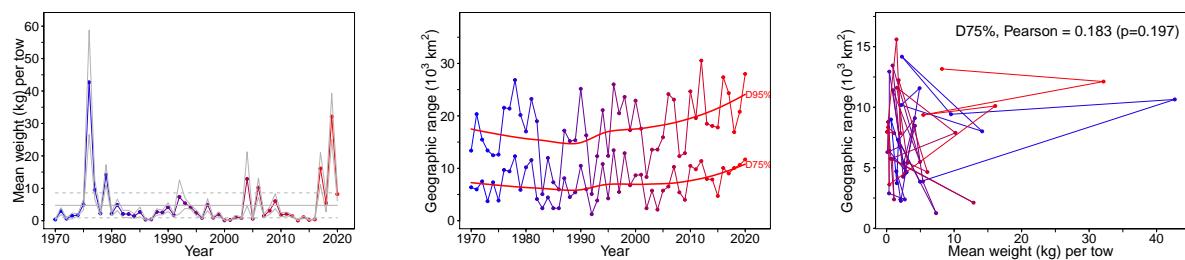


Figure 7.25B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Northern shortfin squid.

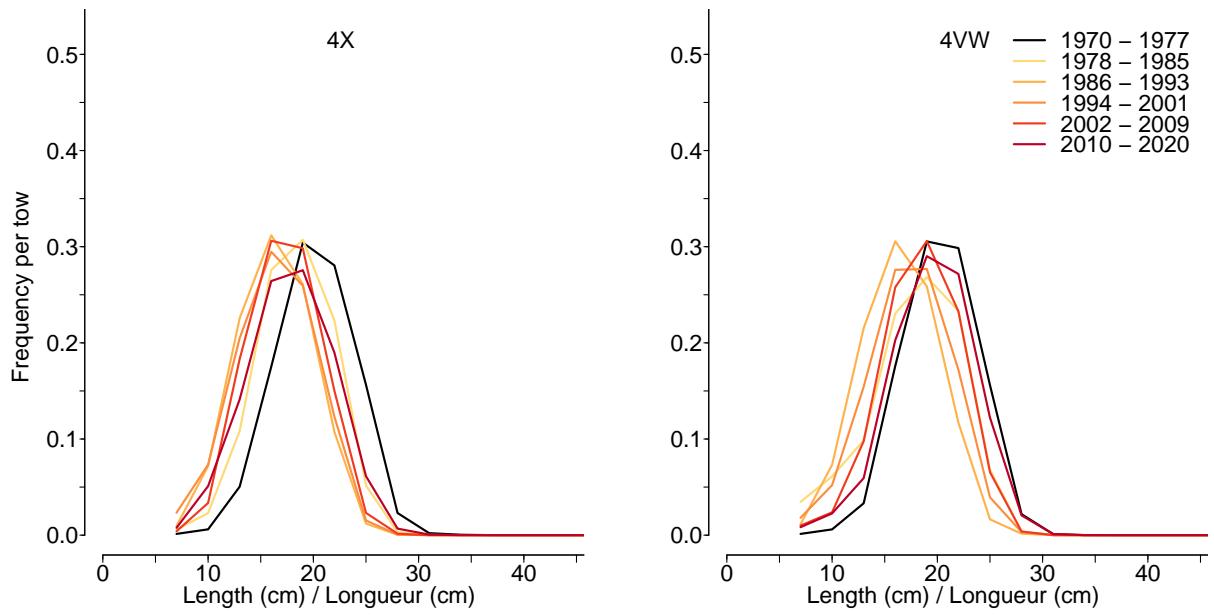


Figure 7.25C. Length frequency distribution in NAFO units 4X and 4VW for Northern shortfin squid.

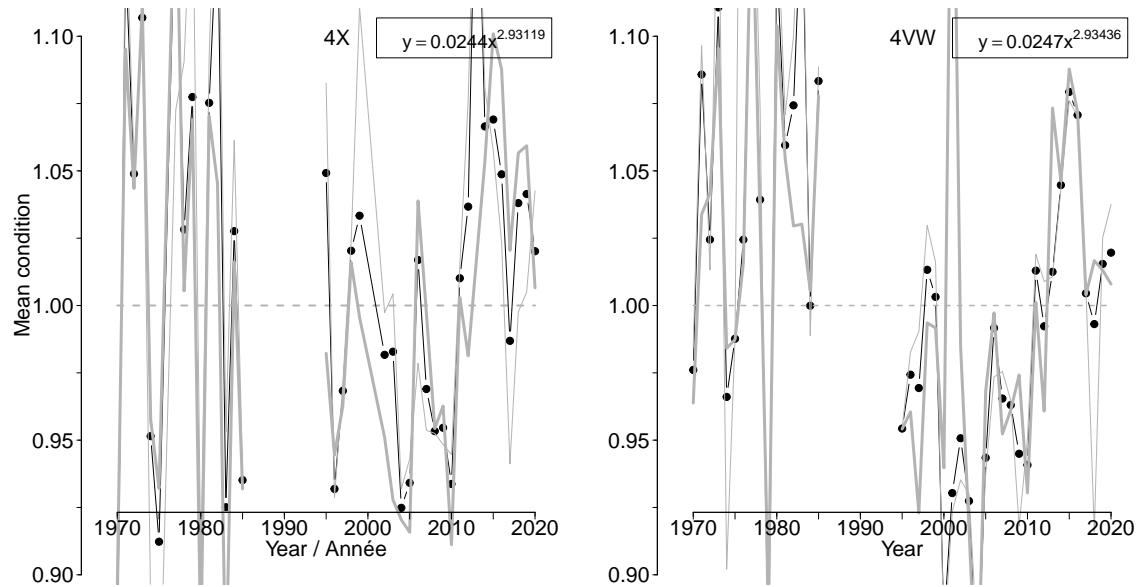


Figure 7.25D. Average fish condition in NAFO units 4X and 4VW for Northern shortfin squid.

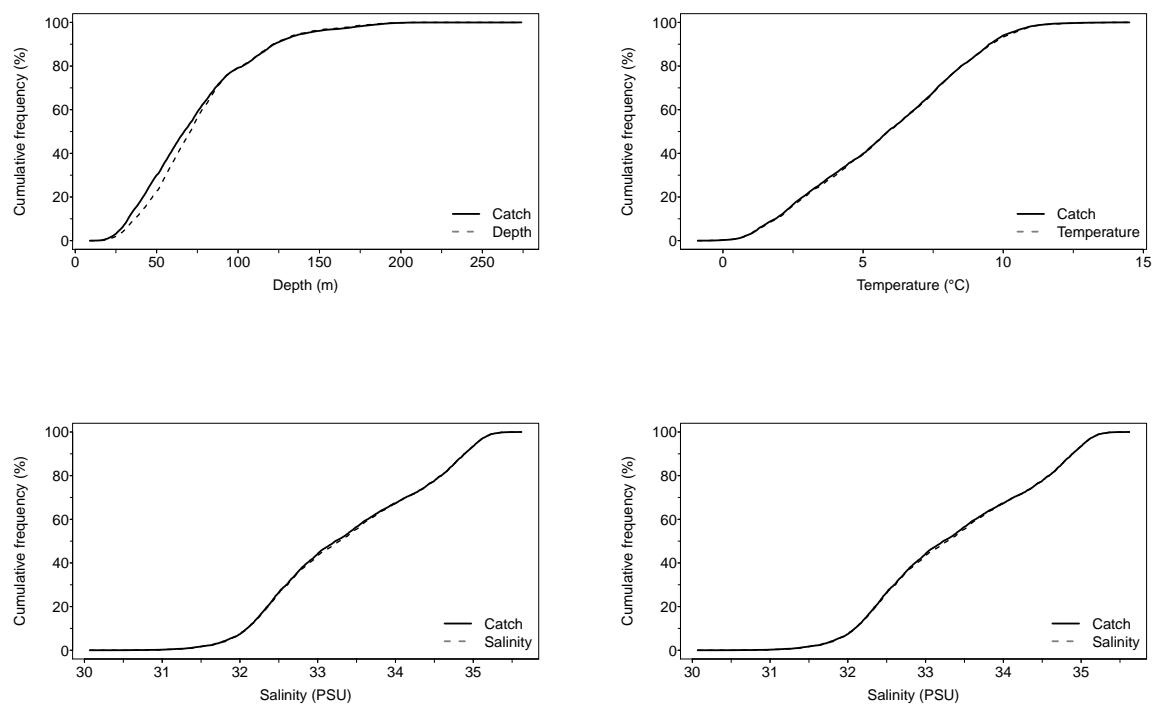


Figure 7.25E. Catch distribution by depth, temperature and salinity of Northern shortfin squid.

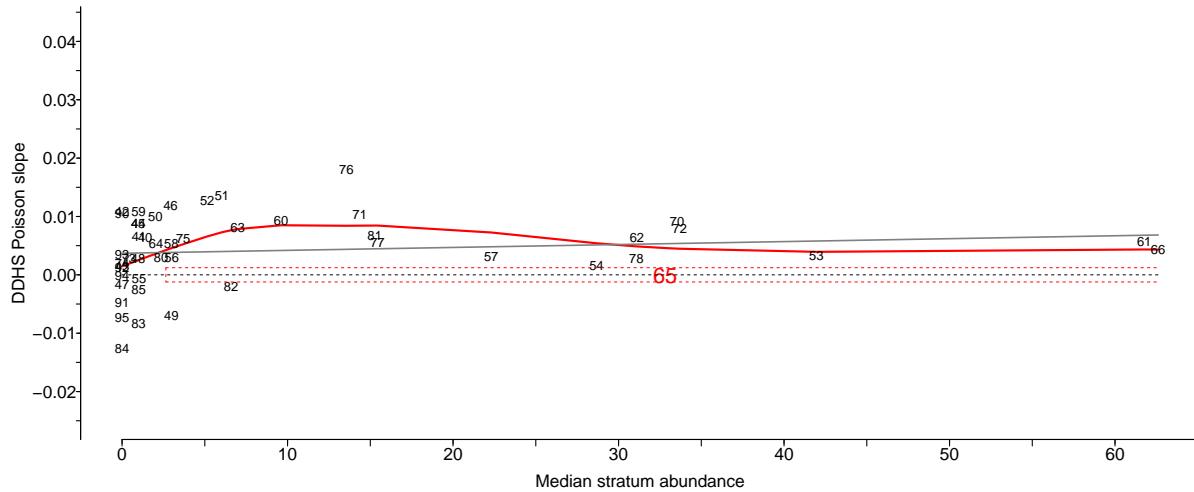


Figure 7.25F. DDHS slopes versus median stratum abundance. The last two digits of each stratum number is shown in the figure for Northern shortfin squid.

## 7.26 Northern prawn (Crevette nordique) - species code 2211 (category SF)

Scientific name: [Pandalus borealis](#)

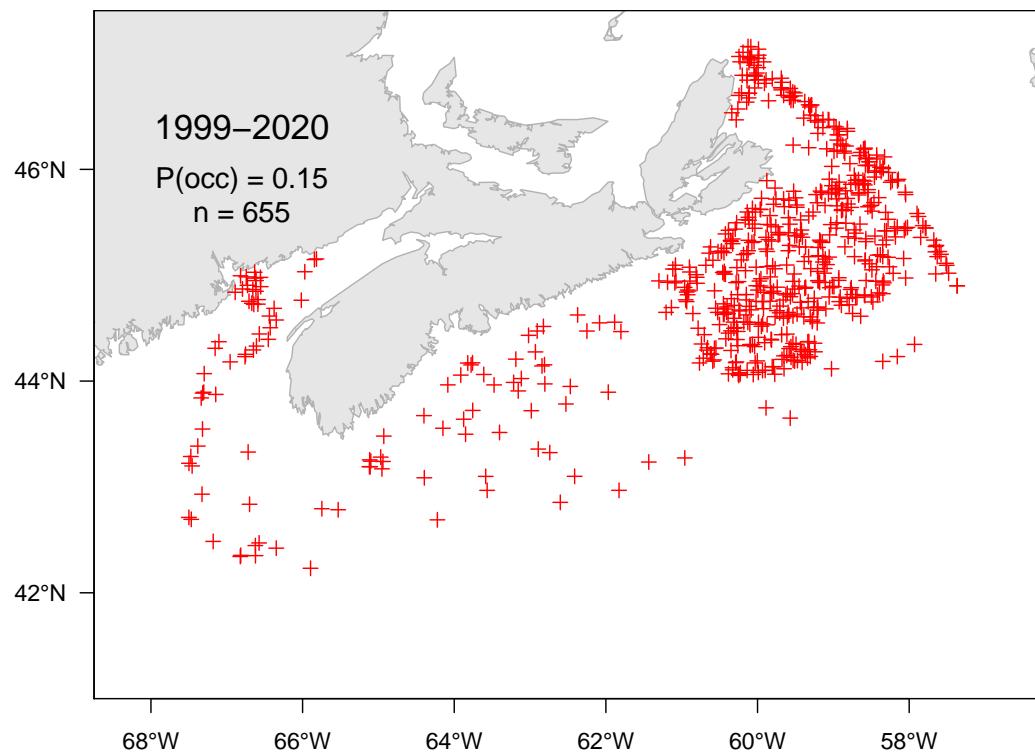


Figure 7.26A. Catch distribution for Northern prawn.

## 7.27 Jonah crab (*Tourteau jona*) - species code 2511 (category SF)

Scientific name: [Cancer borealis](#)

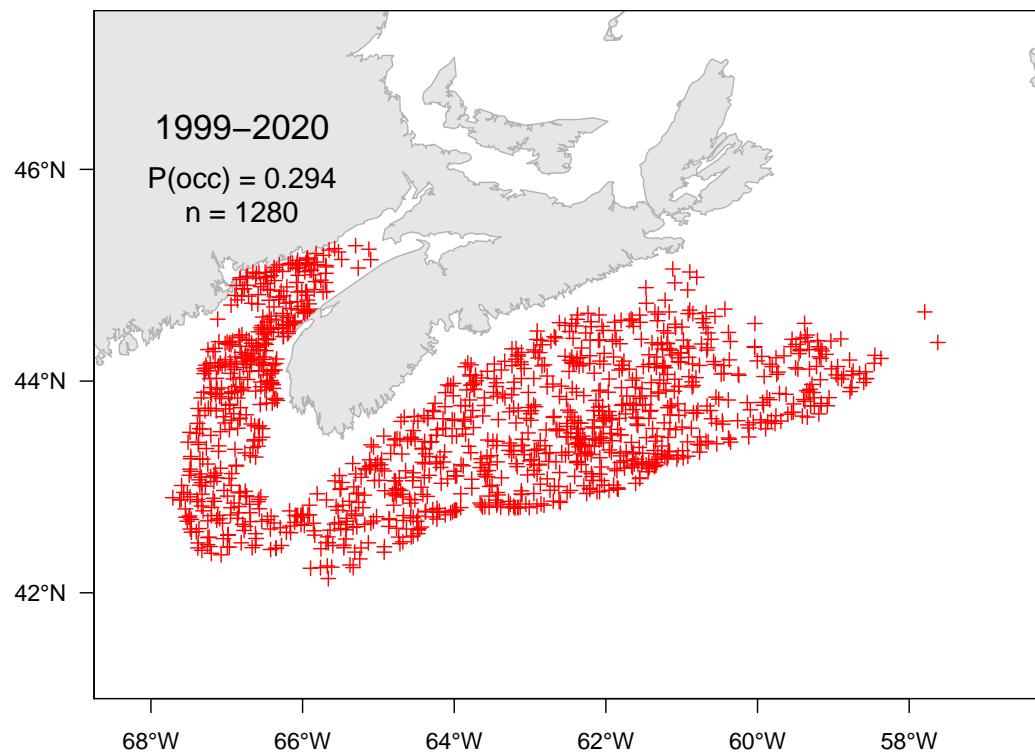


Figure 7.27A. Catch distribution for Jonah crab.

## 7.28 Atlantic rock crab (Tourteau poïnclos) - species code 2513 (category SF)

Scientific name: [Cancer irroratus](#)

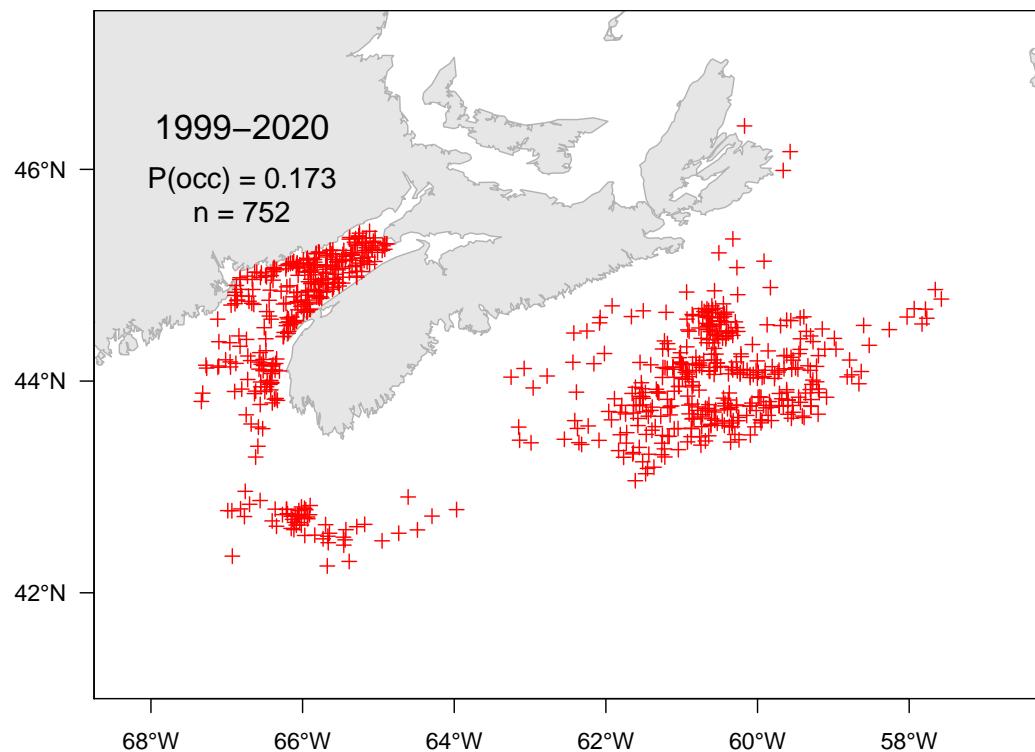


Figure 7.28A. Catch distribution for Atlantic rock crab.

## 7.29 Arctic lyre crab (*Crabe Hyas coarctatus*) - species code 2521 (category SF)

Scientific name: [Hyas coarctatus](#)

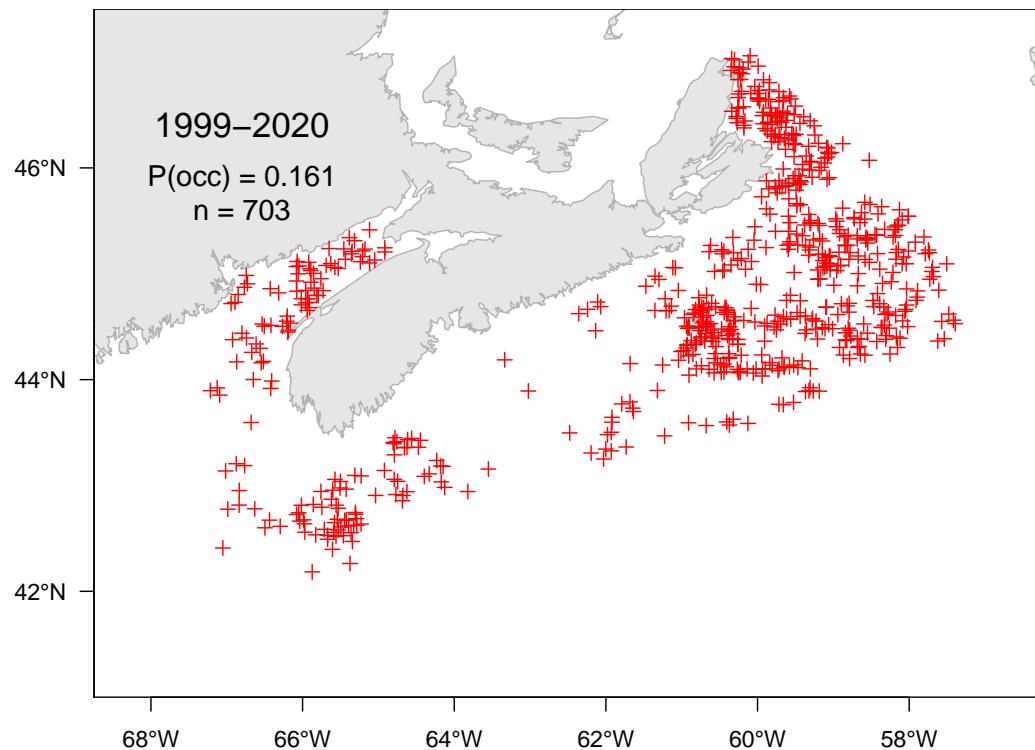


Figure 7.29A. Catch distribution for Arctic lyre crab.

### 7.30 Atlantic king crab (Crabe épineux du nord) - species code 2523 (category SF)

Scientific name: [Lithodes maja](#)

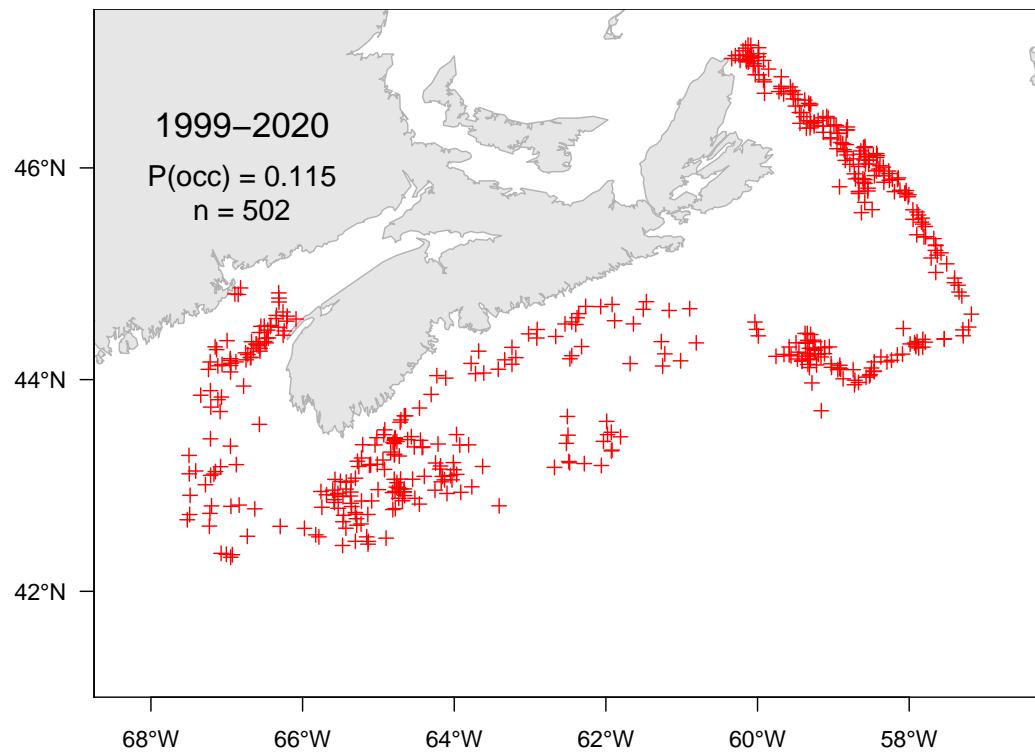


Figure 7.30A. Catch distribution for Atlantic king crab.

### 7.31 Queen crab (Crabe des neiges) - species code 2526 (category SF)

Scientific name: [Chionoecetes opilio](#)

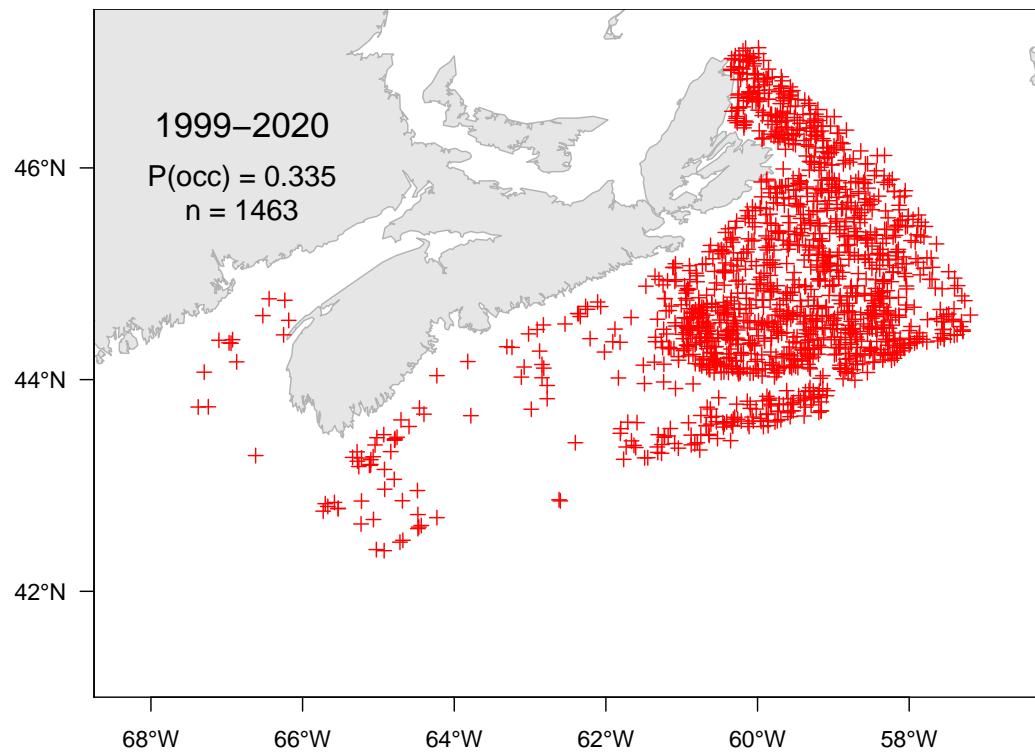


Figure 7.31A. Catch distribution for Queen crab.

### 7.32 Great spider crab (Crabe lyre araignée) - species code 2527 (category SF)

Scientific name: [Hyas araneus](#)

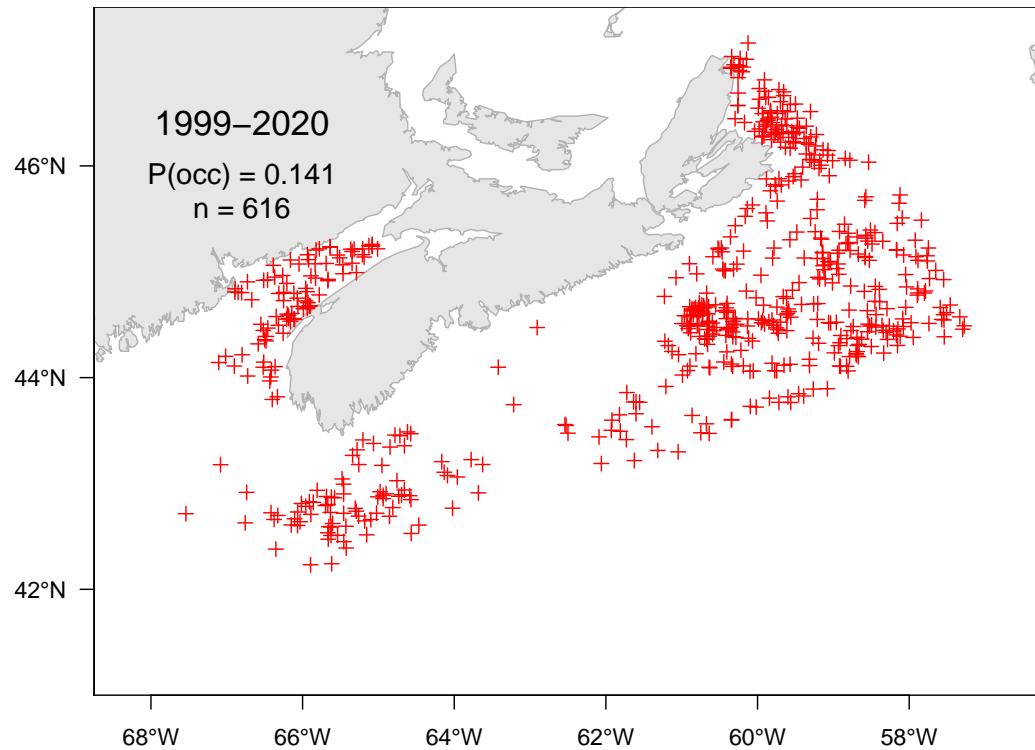


Figure 7.32A. Catch distribution for Great spider crab.

### 7.33 American lobster (Homard américain) - species code 2550 (category SF)

Scientific name: [Homarus americanus](#)

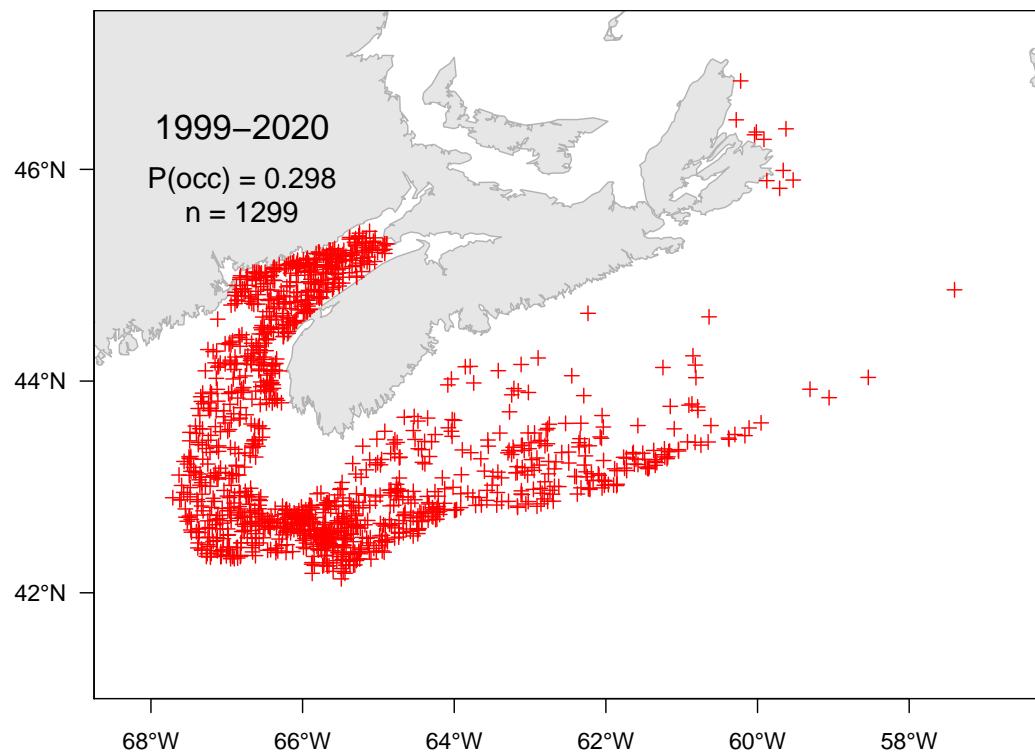


Figure 7.33A. Catch distribution for American lobster.

### 7.34 Sea lamprey (*Lamproie marine*) - species code 240 (category LR)

Scientific name: [Petromyzon marinus](#)

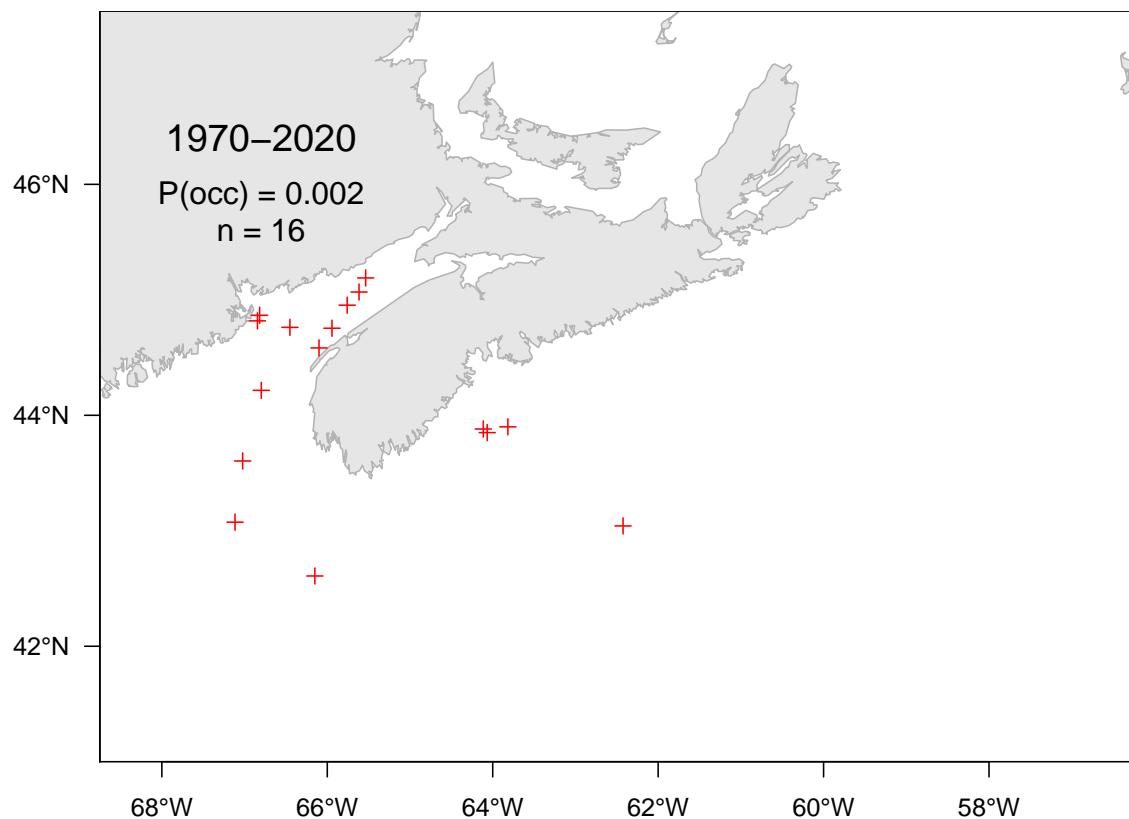


Figure 7.34A. Catch distribution for Sea lamprey.

### 7.35 Atlantic tomcod (*Poulamon atlantique*) - species code 17 (category LR)

Scientific name: [Micogadus tomcod](#)

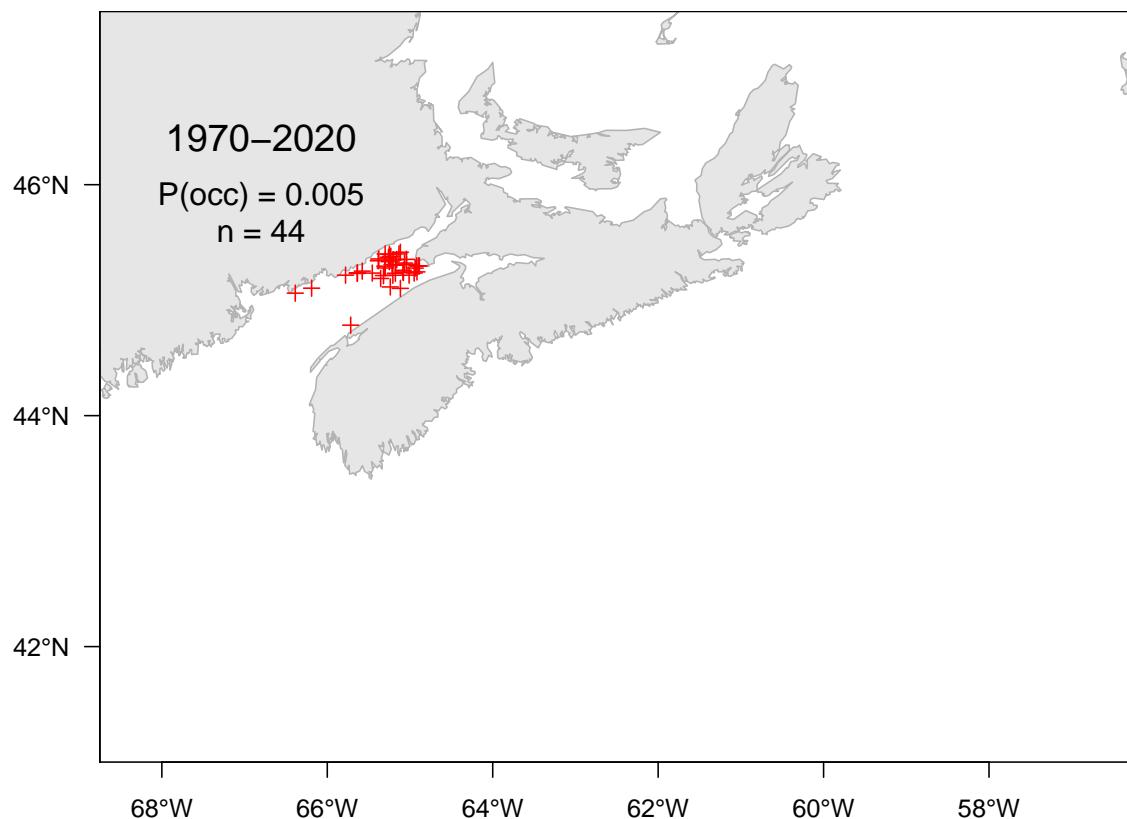


Figure 7.35A. Catch distribution for Atlantic tomcod.

### 7.36 Offshore silver hake (Merlu argenté du large) - species code 19 (category LR)

Scientific name: [Merluccius albidus](#)

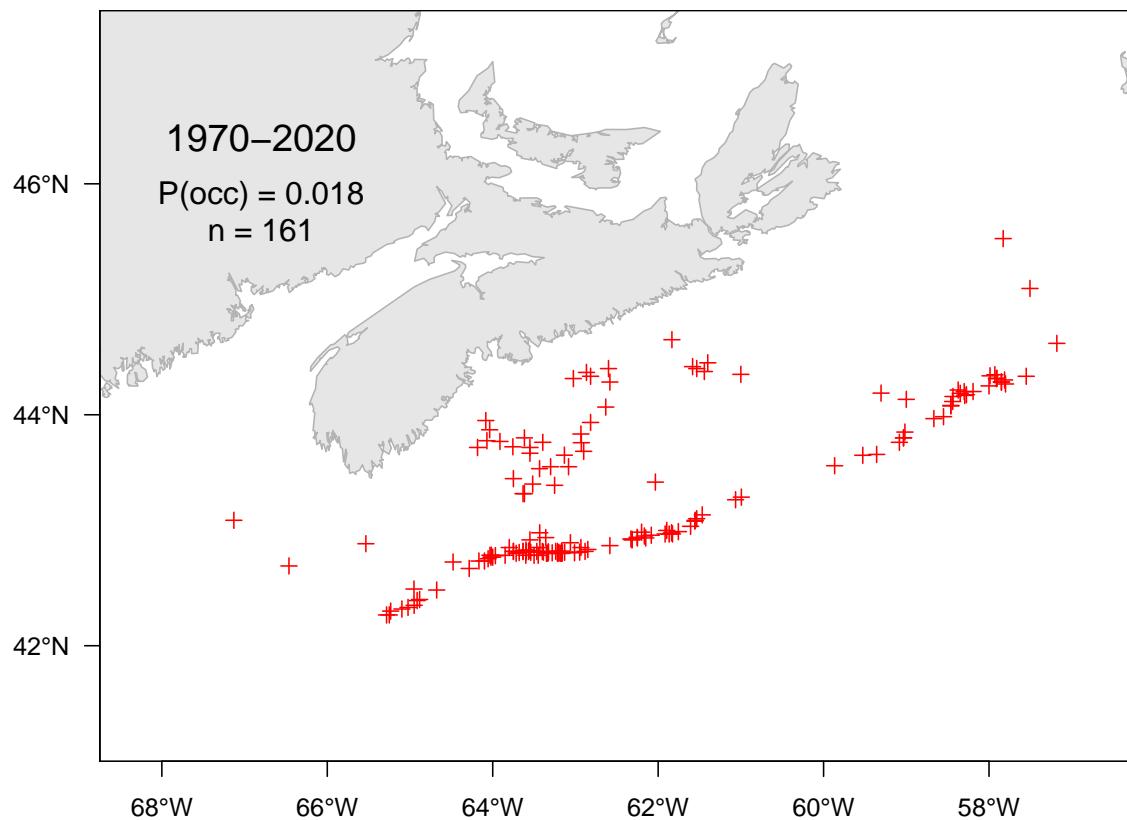


Figure 7.36A. Catch distribution for Offshore silver hake.

### 7.37 Spotted wolffish (*Loup tacheté*) - species code 51 (category LR)

Scientific name: [Anarhichas minor](#)

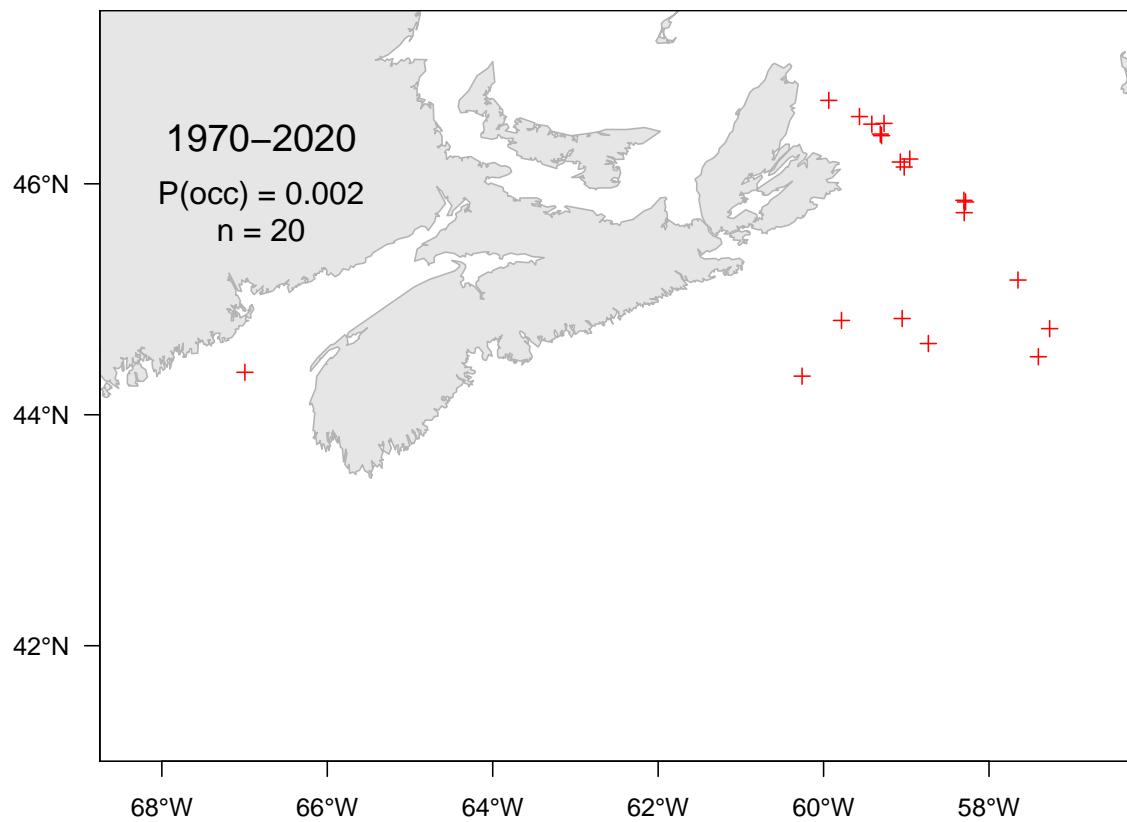


Figure 7.37A. Catch distribution for Spotted wolffish.

### 7.38 Northern wolffish (Loup à tête large) - species code 52 (category LR)

Scientific name: [Anarhichas denticulatus](#)

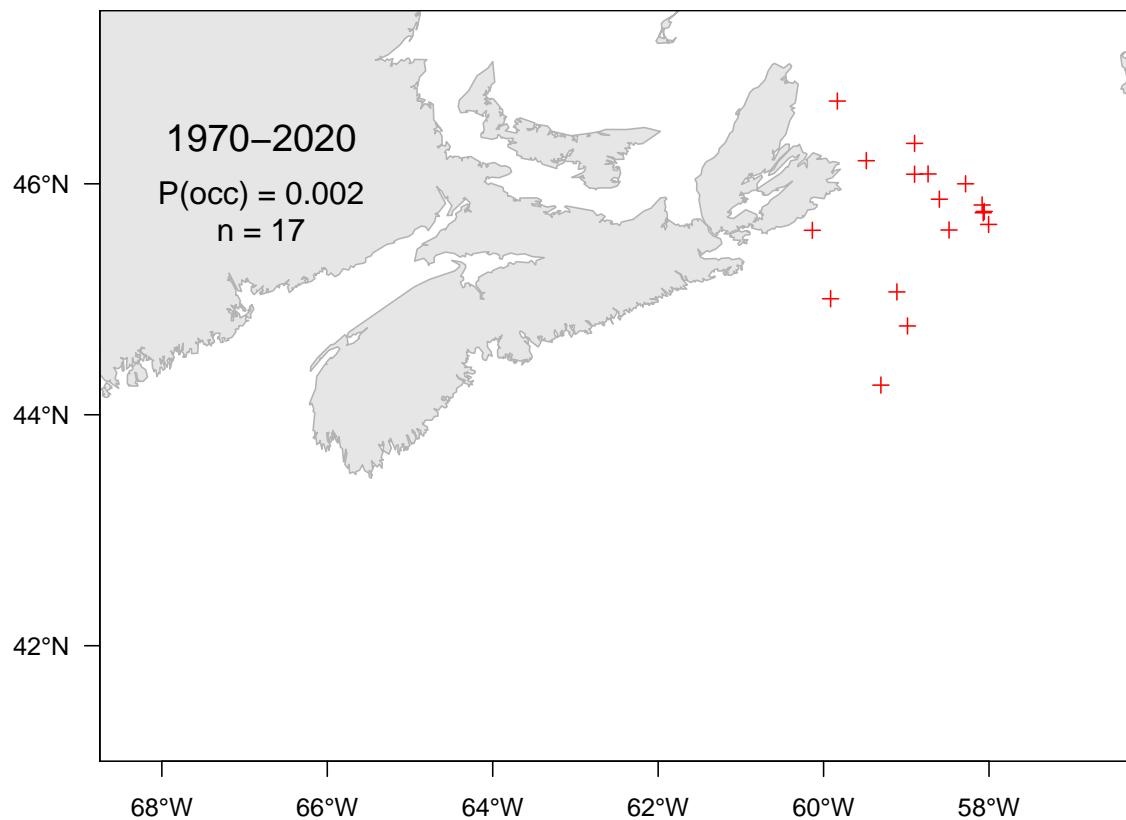


Figure 7.38A. Catch distribution for Northern wolffish.

### 7.39 Rainbow smelt (Éperlan arc-en-ciel) - species code 63 (category LR)

Scientific name: [Osmerus mordax](#)

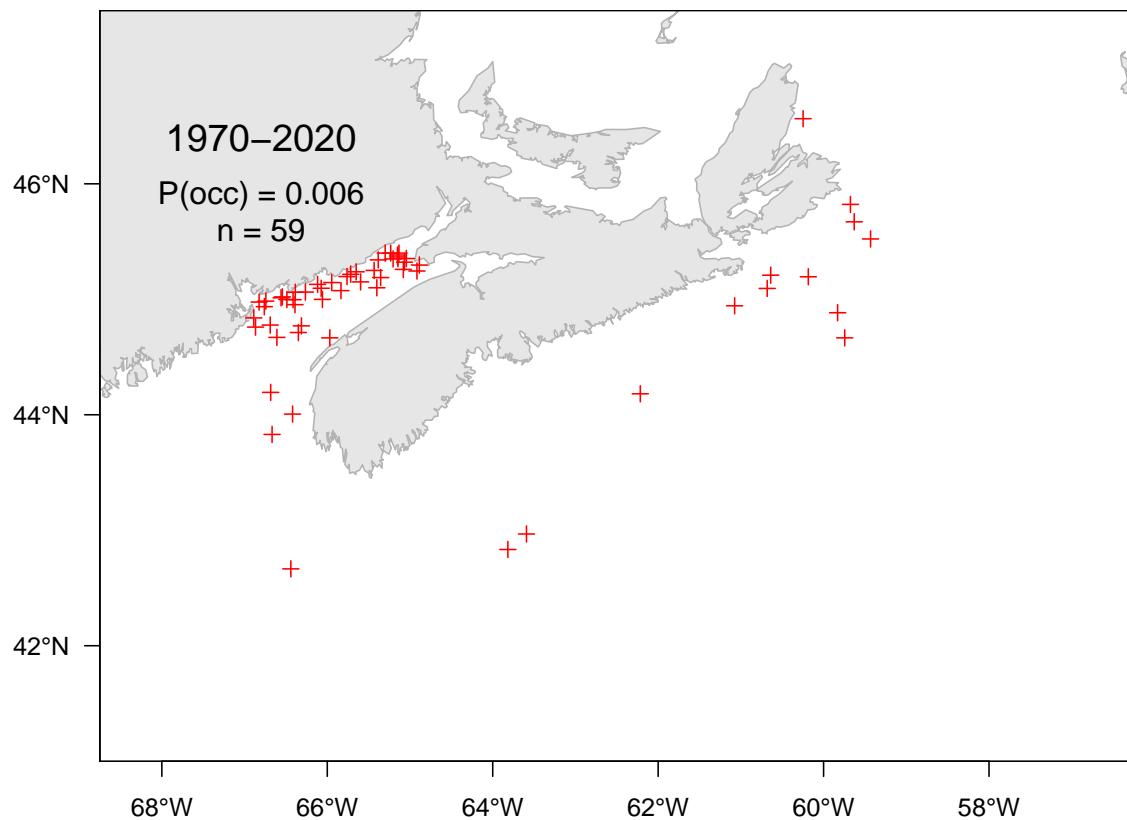


Figure 7.39A. Catch distribution for Rainbow smelt.

#### 7.40 Cunner (Tanche-tautogue) - species code 122 (category LR)

Scientific name: [Tautogolabrus adspersus](#)

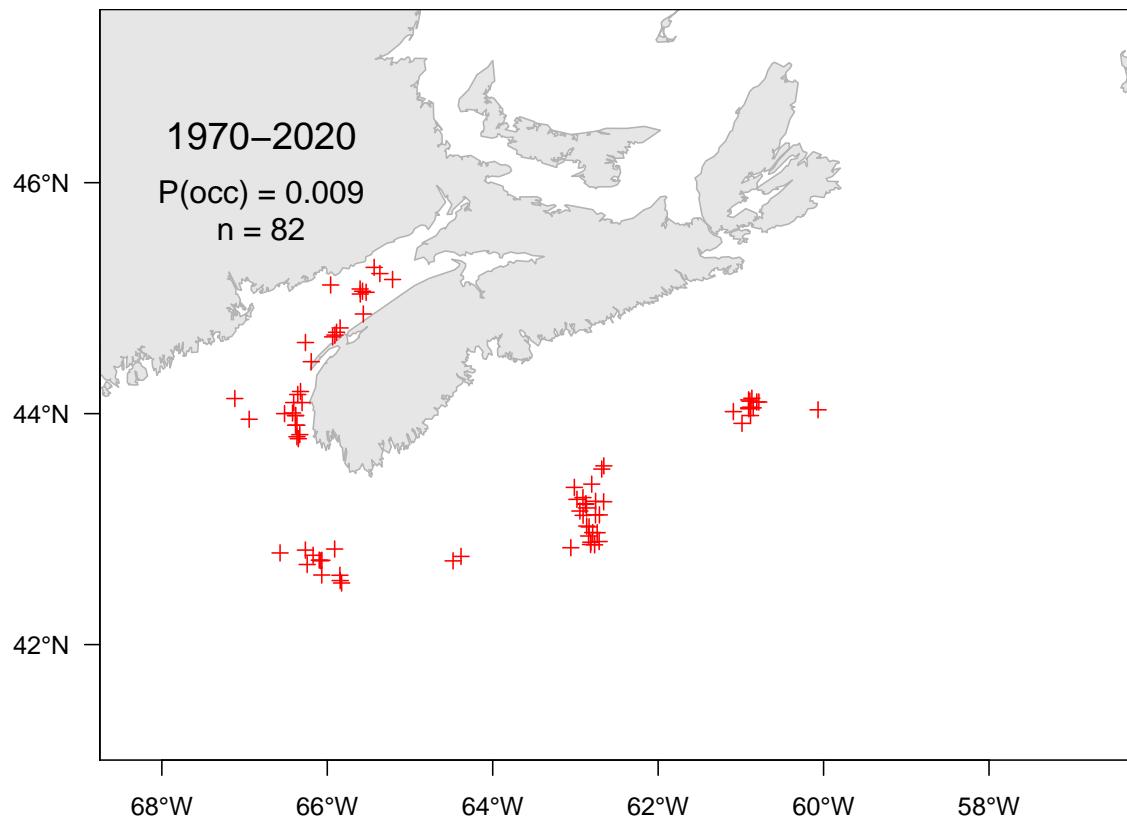


Figure 7.40A. Catch distribution for Cunner.

#### 7.41 Fourspot flounder (Cardeau à quatre ocelles) - species code 142 (category LR)

Scientific name: [Hippoglossina oblonga](#)

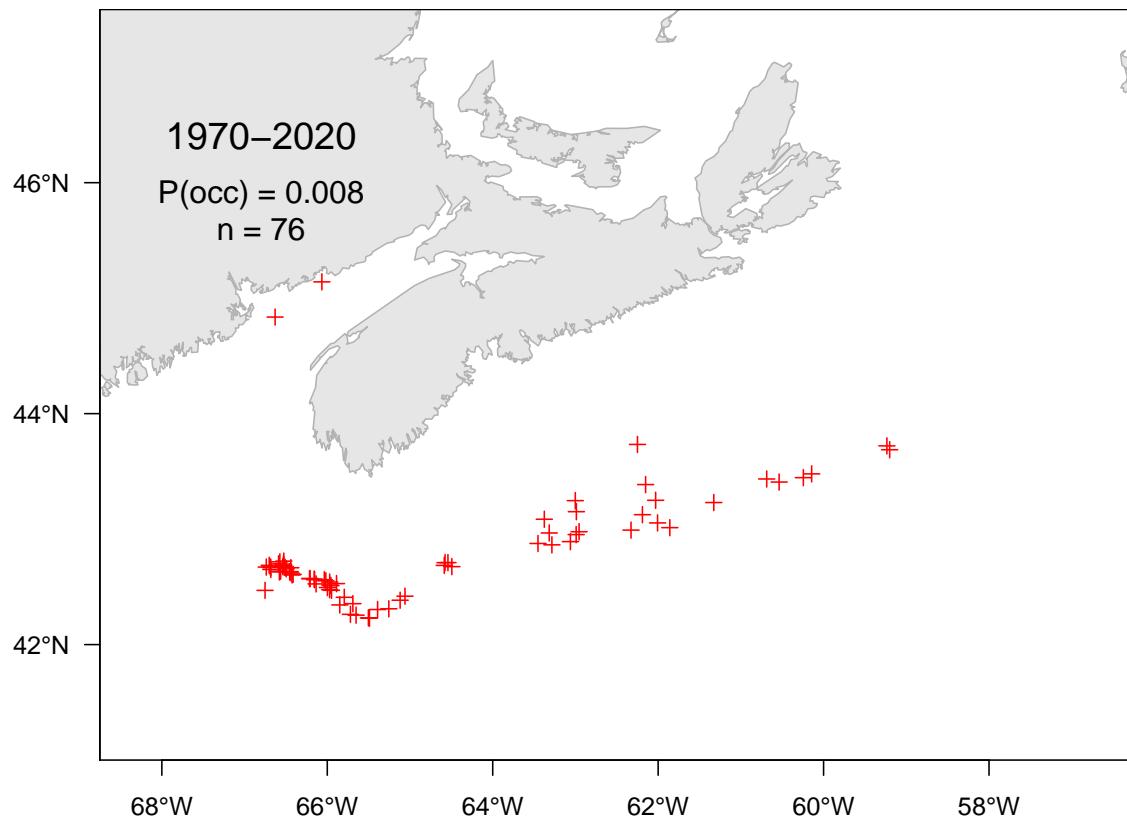


Figure 7.41A. Catch distribution for Fourspot flounder.

## 7.42 Windowpane flounder (Turbot de sable) - species code 143 (category LR)

Scientific name: [Scophthalmus aquosus](#)

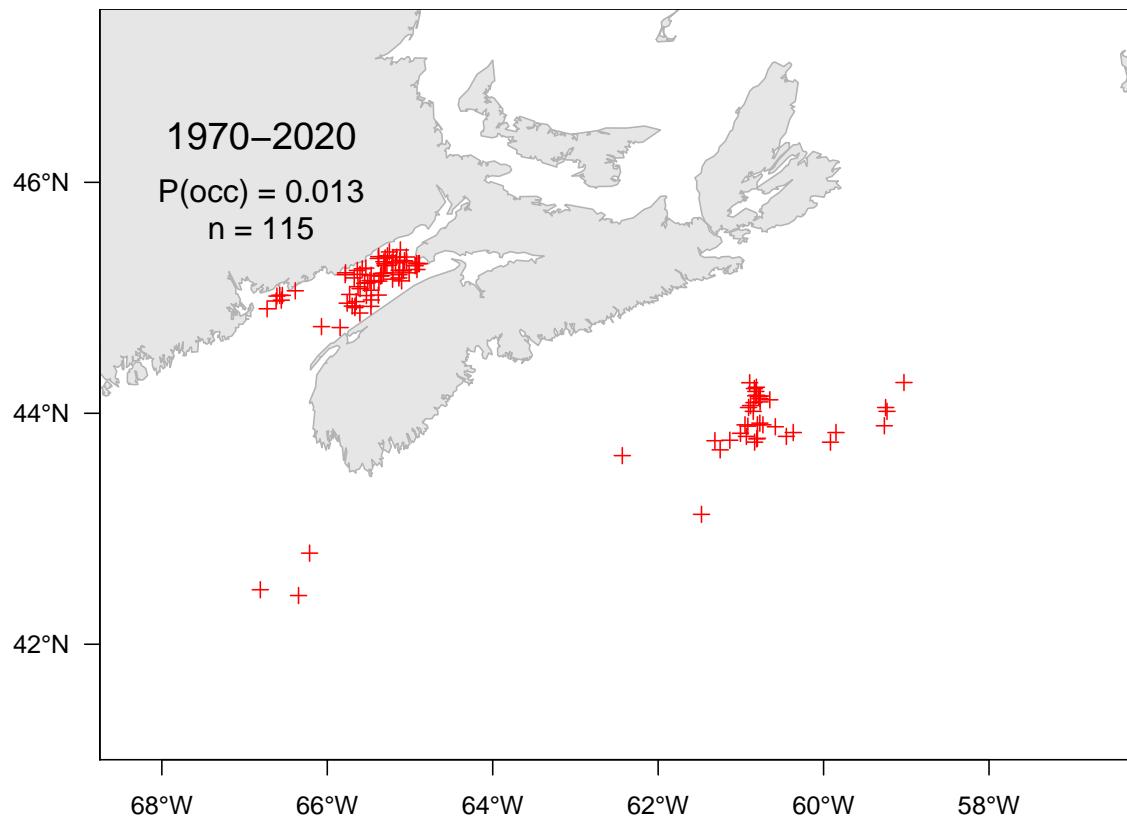


Figure 7.42A. Catch distribution for Windowpane flounder.

#### 7.43 Longnose greeneye (Oeil-vert à long nez) - species code 149 (category LR)

Scientific name: [Parasudis triculenta](#)

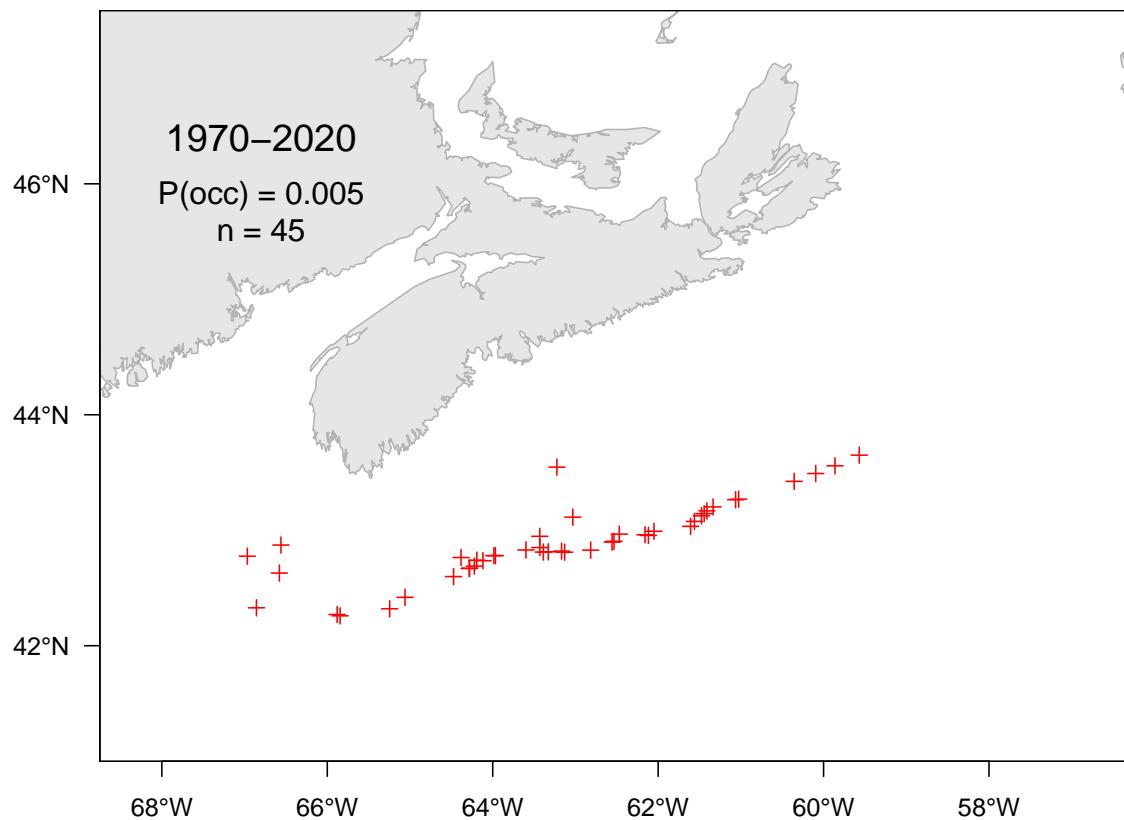


Figure 7.43A. Catch distribution for Longnose greeneye.

#### 7.44 Lanternfishes (Poissons-lanternes) - species code 150 (category LR)

Scientific name: [Myctophidae](#)

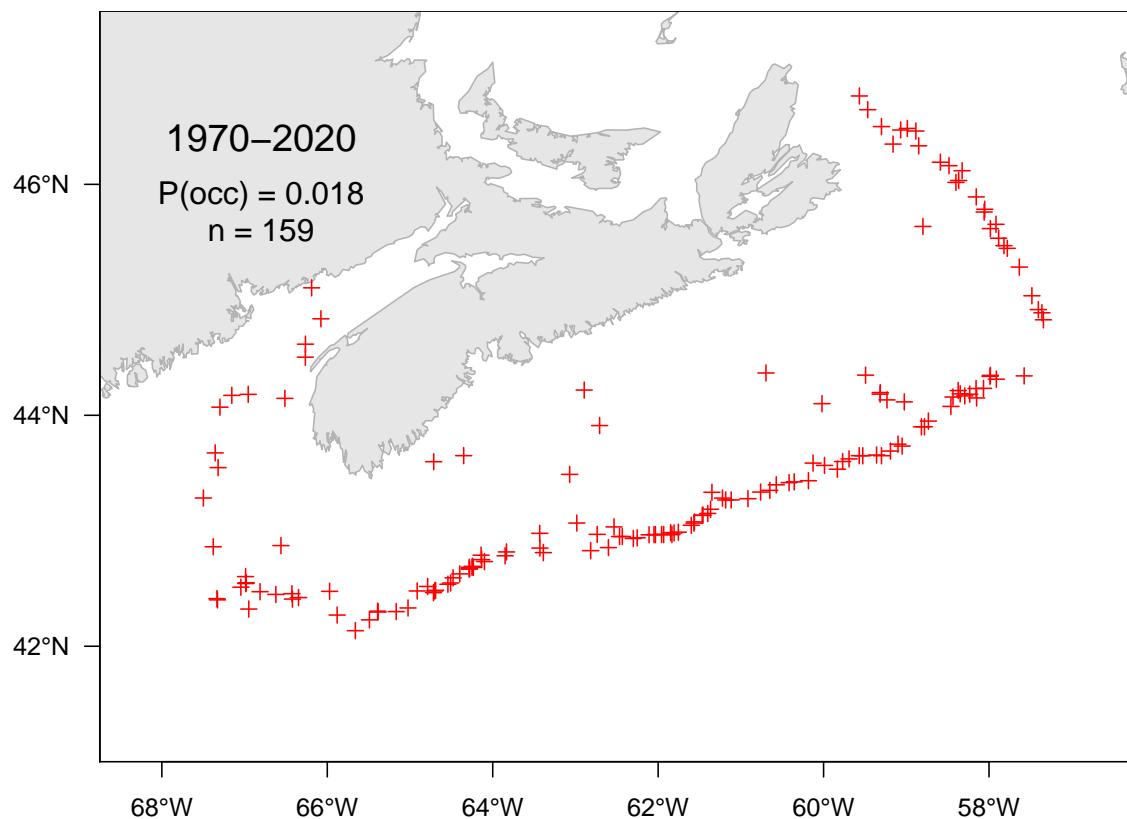


Figure 7.44A. Catch distribution for Lanternfishes.

## 7.45 Shortnose greeneye (Éperlan du large) - species code 156 (category LR)

Scientific name: [Chlorophthalmus agassizi](#)

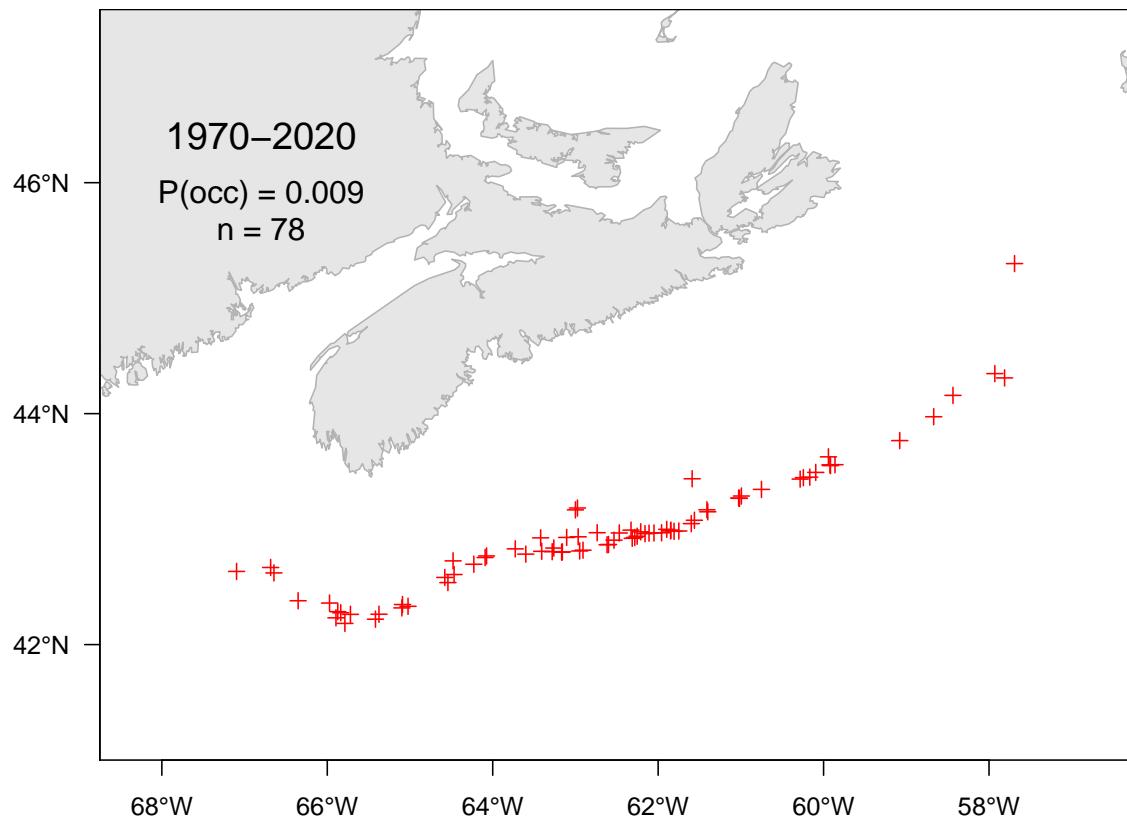


Figure 7.45A. Catch distribution for Shortnose greeneye.

#### 7.46 Silvery lightfish (Brossé améthyste) - species code 158 (category LR)

Scientific name: [Maurolicus muelleri](#)

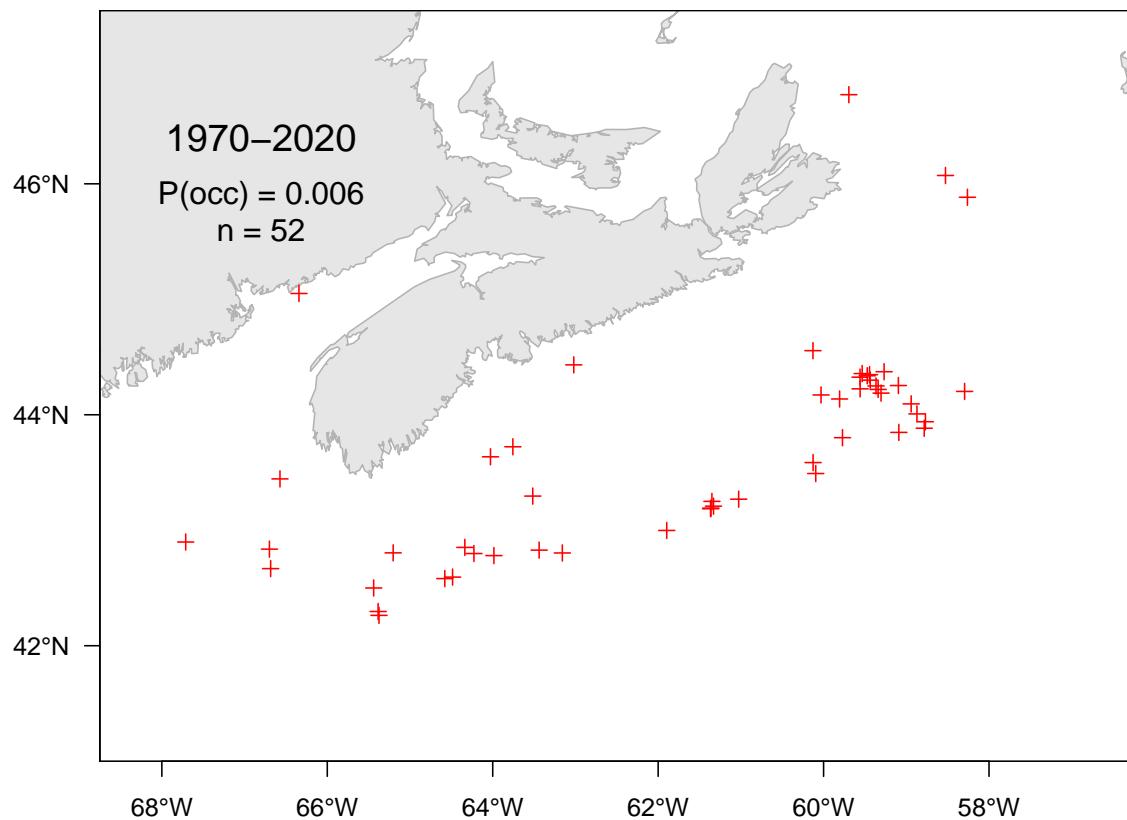


Figure 7.46A. Catch distribution for Silvery lightfish.

### 7.47 Boa dragonfish (Dragon-boa) - species code 159 (category LR)

Scientific name: [Stomias boa](#)

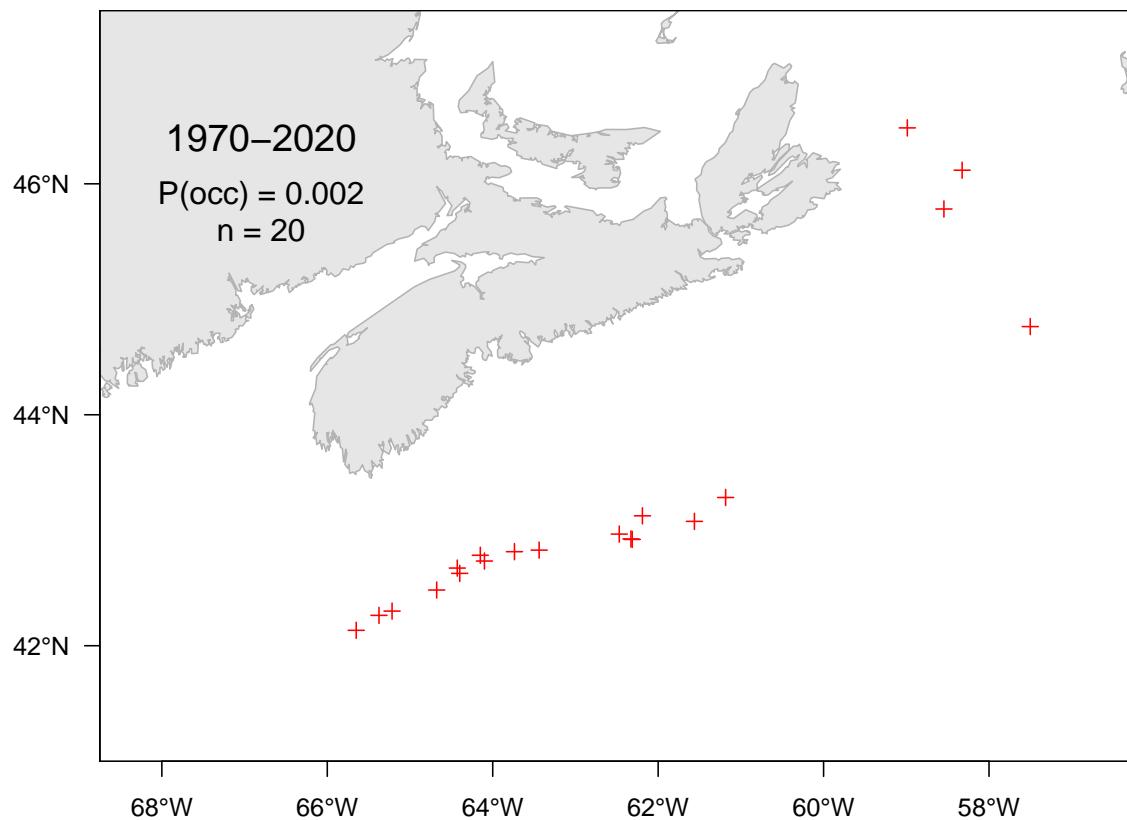


Figure 7.47A. Catch distribution for Boa dragonfish.

**7.48 Shorthorn sculpin (Chabosseau à épines courtes) - species code 301 (category LR)**

Scientific name: [Myoxocephalus scorpius](#)

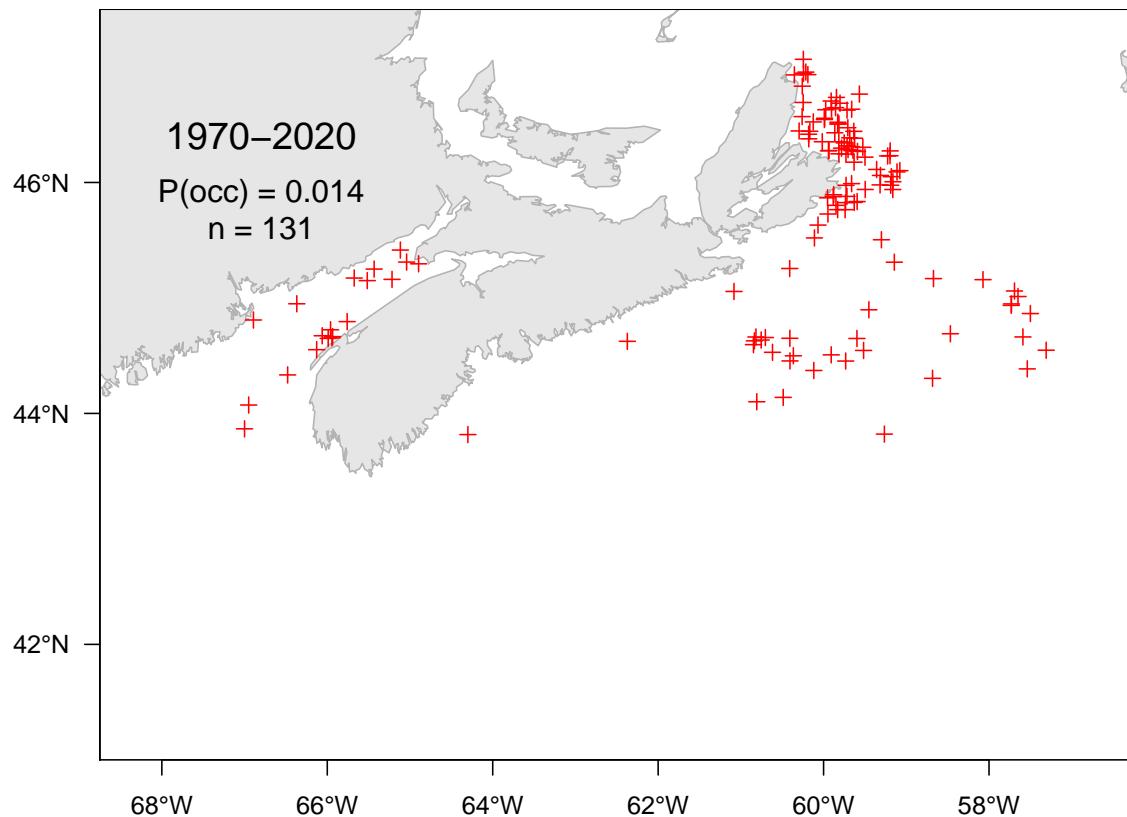


Figure 7.48A. Catch distribution for Shorthorn sculpin.

#### 7.49 Grubby (Chaboisseau bronzé) - species code 303 (category LR)

Scientific name: [Myoxocephalus aenaeus](#)

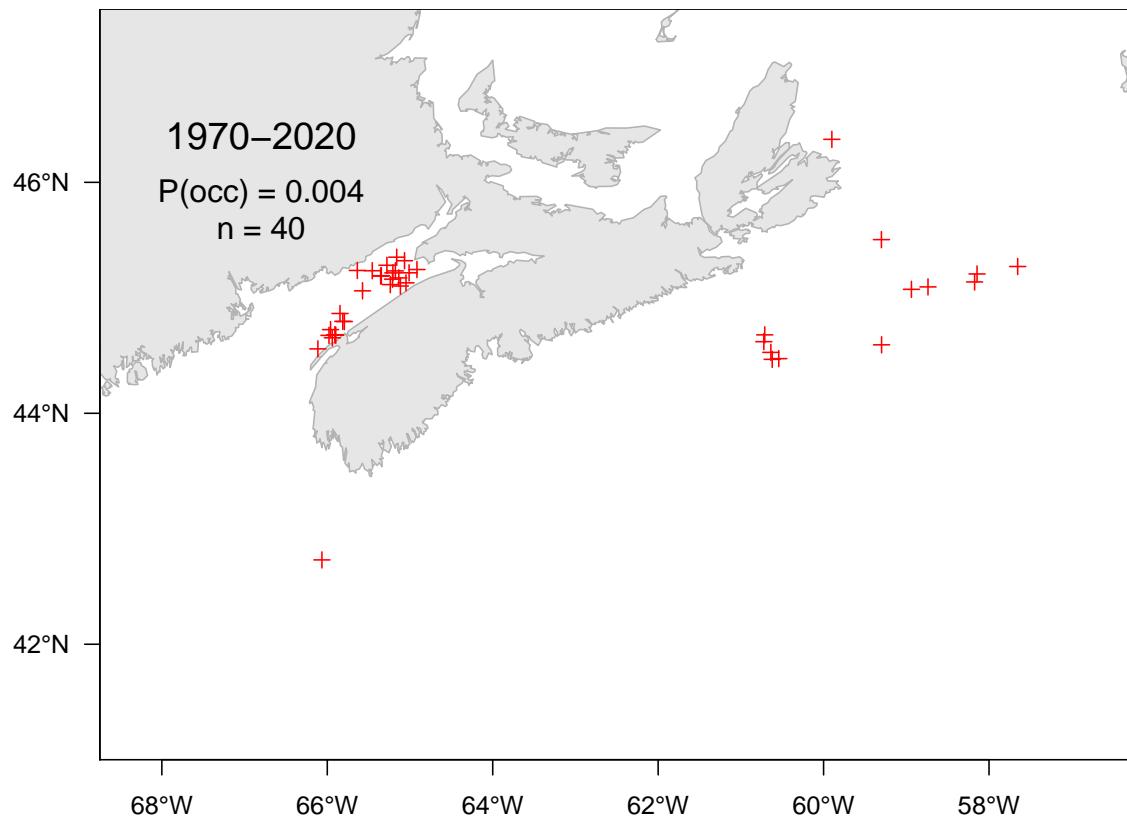


Figure 7.49A. Catch distribution for Grubby.

## 7.50 Polar sculpin (Cotte polaire) - species code 307 (category LR)

Scientific name: [Cottunculus microps](#)

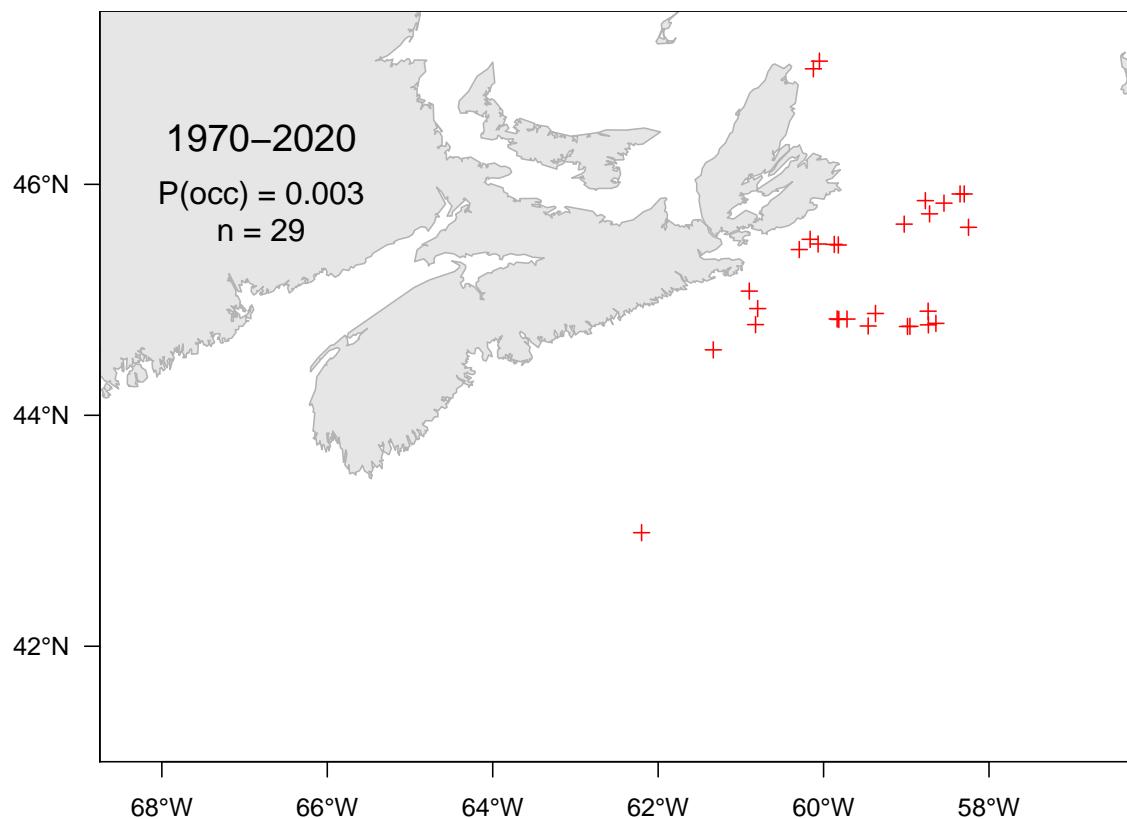
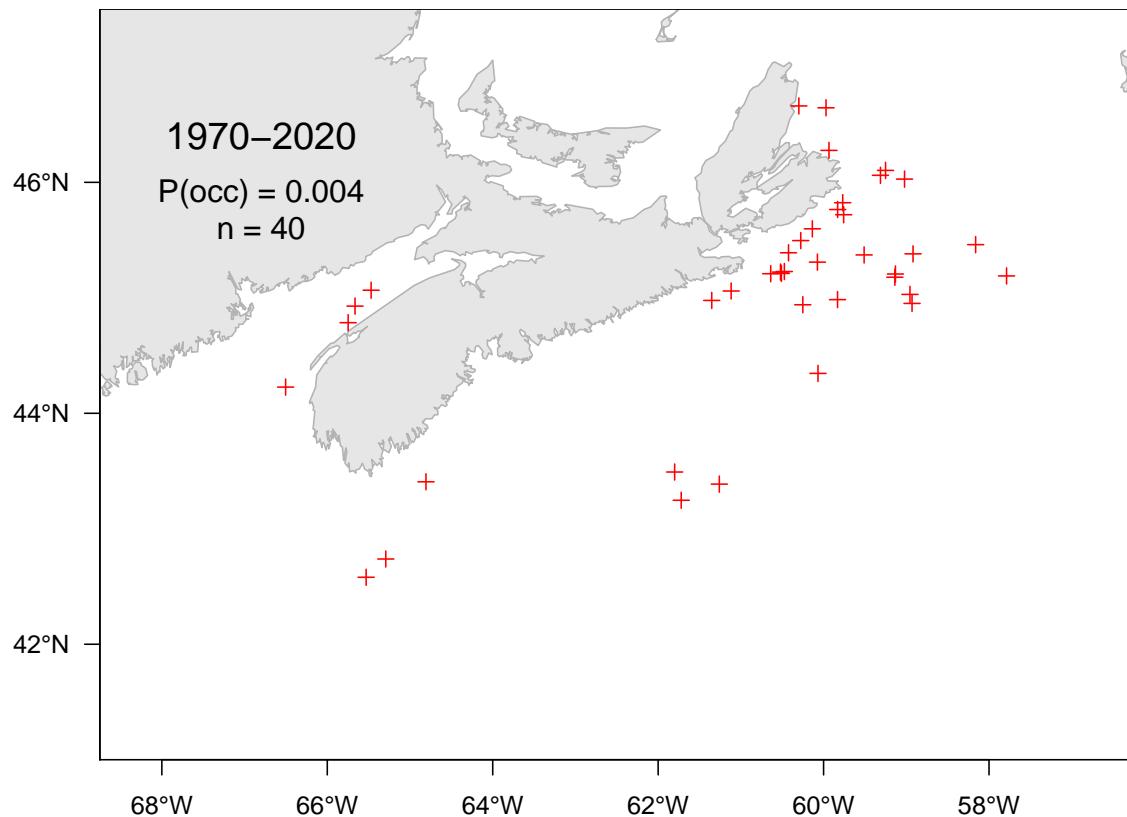


Figure 7.50A. Catch distribution for Polar sculpin.

### 7.51 Spatulate sculpin (Icèle spatulée) - species code 314 (category LR)

Scientific name: [Icelus spatula](#)



## 7.52 Arctic alligatorfish (Poisson-alligator arctique) - species code 341 (category LR)

Scientific name: [Ulcina olrikii](#)

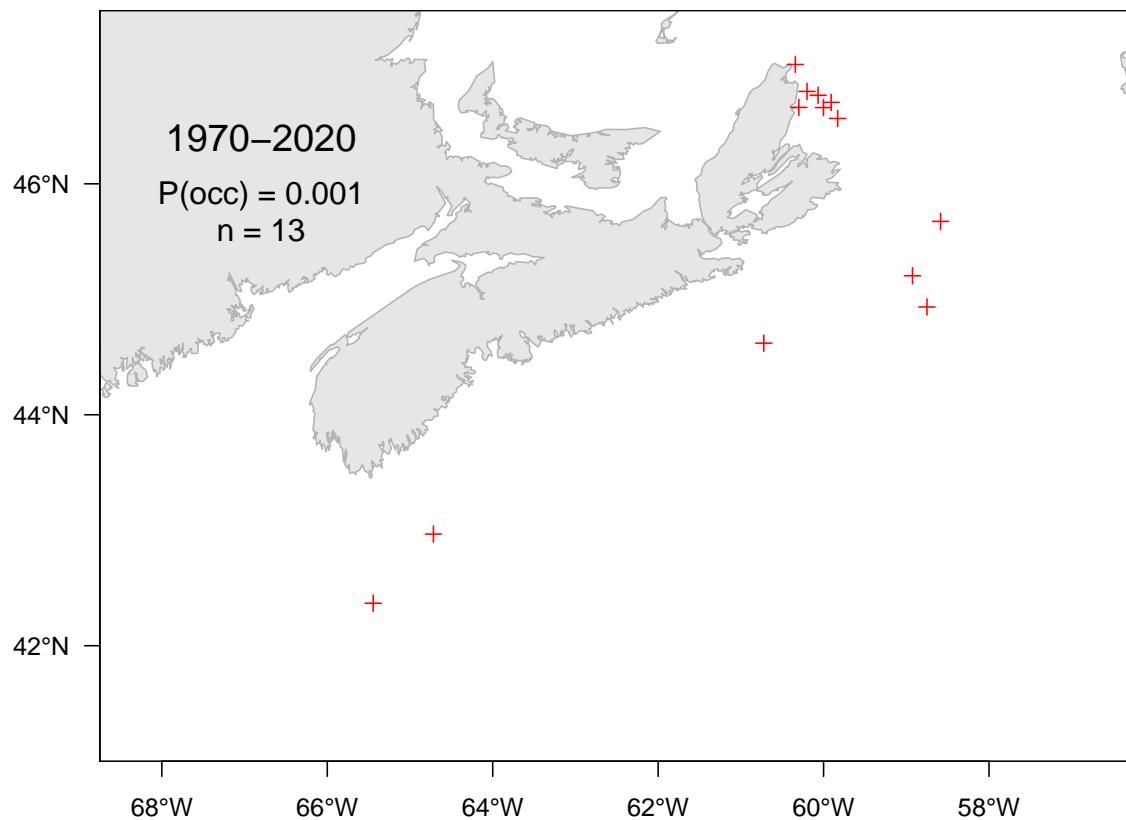


Figure 7.52A. Catch distribution for Arctic alligatorfish.

### 7.53 Alligatorfishes (Poissons-alligator) - species code 351 (category LR)

Scientific name: [Agonidae](#)

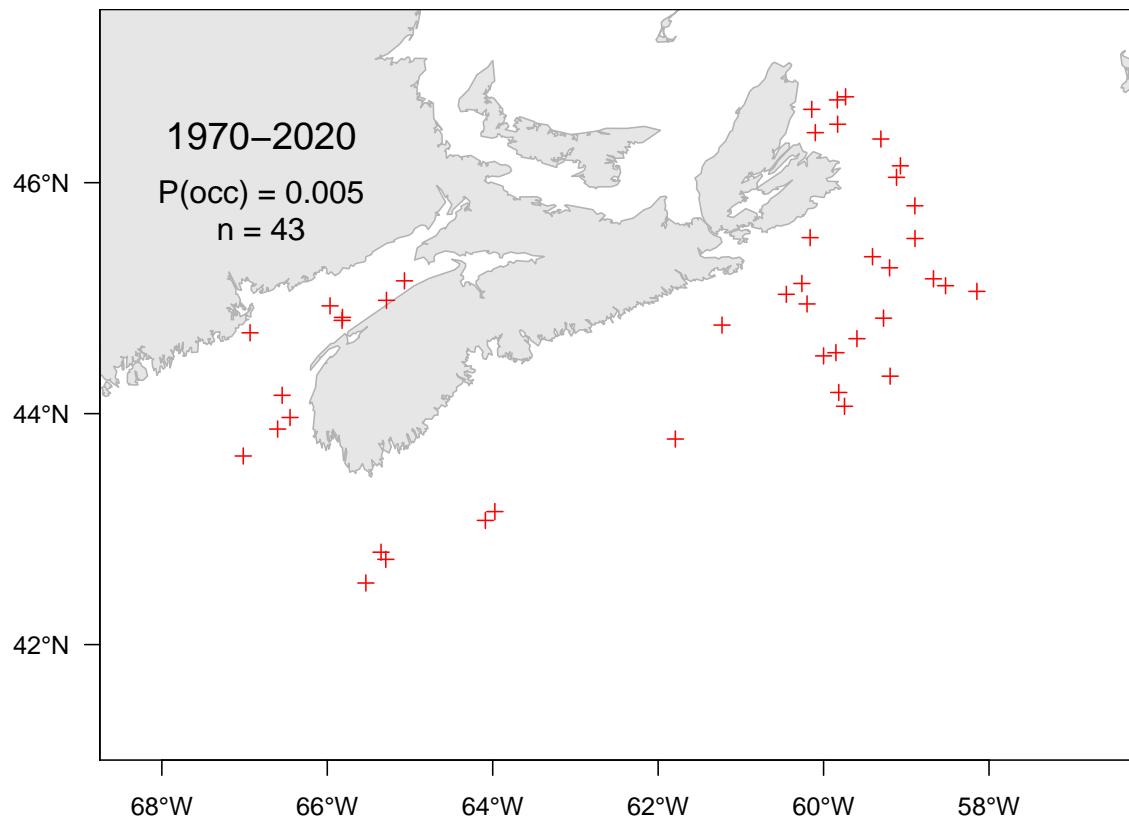


Figure 7.53A. Catch distribution for Alligatorfishes.

## 7.54 Roughnose grenadier (Grenadier-scie) - species code 412 (category LR)

Scientific name: [Trachyrincus murrayi](#)

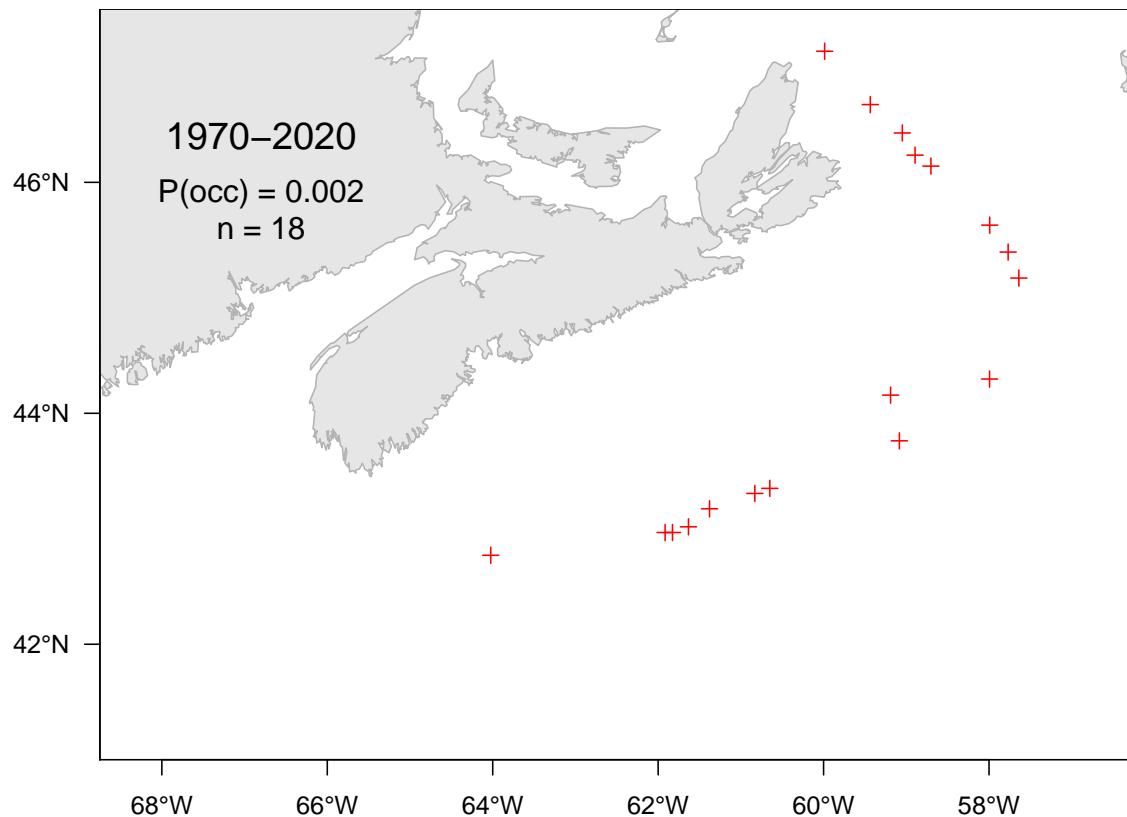


Figure 7.54A. Catch distribution for Roughnose grenadier.

## 7.55 Roundnose grenadier (Grenadier de roche) - species code 414 (category LR)

Scientific name: [Coryphaenoides rupestris](#)

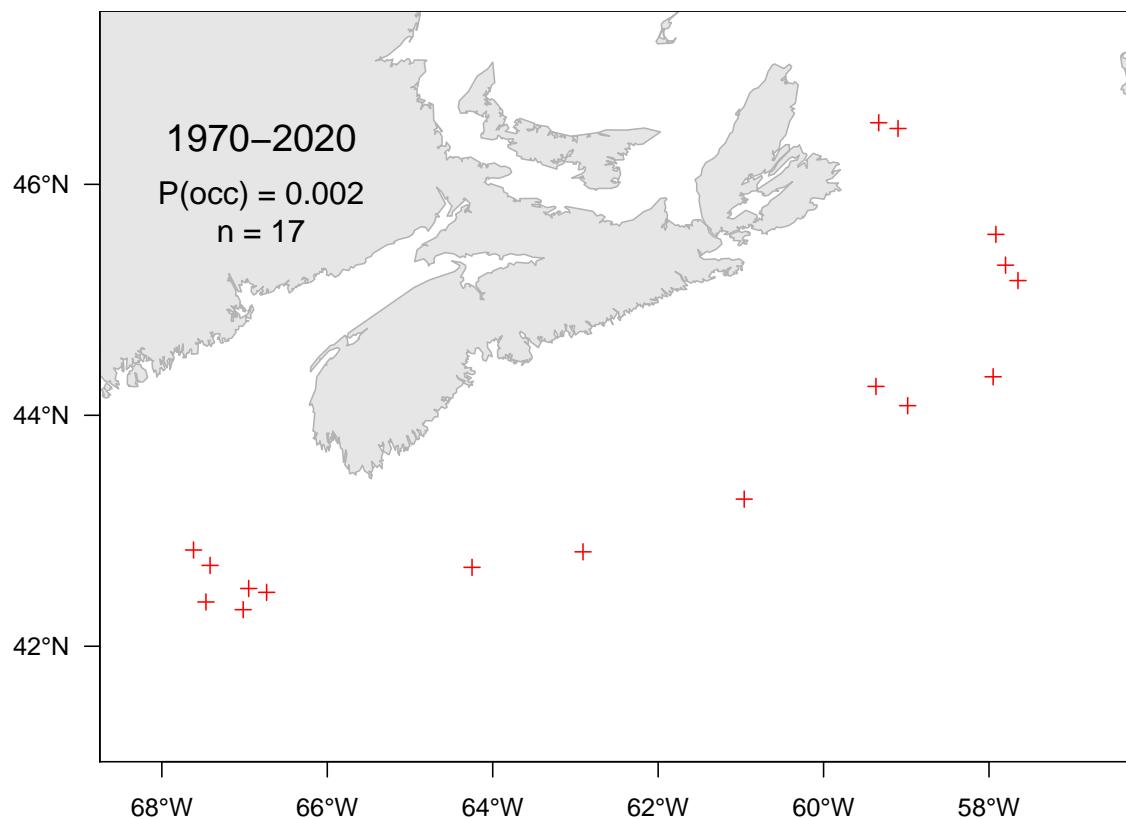


Figure 7.55A. Catch distribution for Roundnose grenadier.

## 7.56 Atlantic seasnail (*Limace atlantique*) - species code 503 (category LR)

Scientific name: [Liparis atlanticus](#)

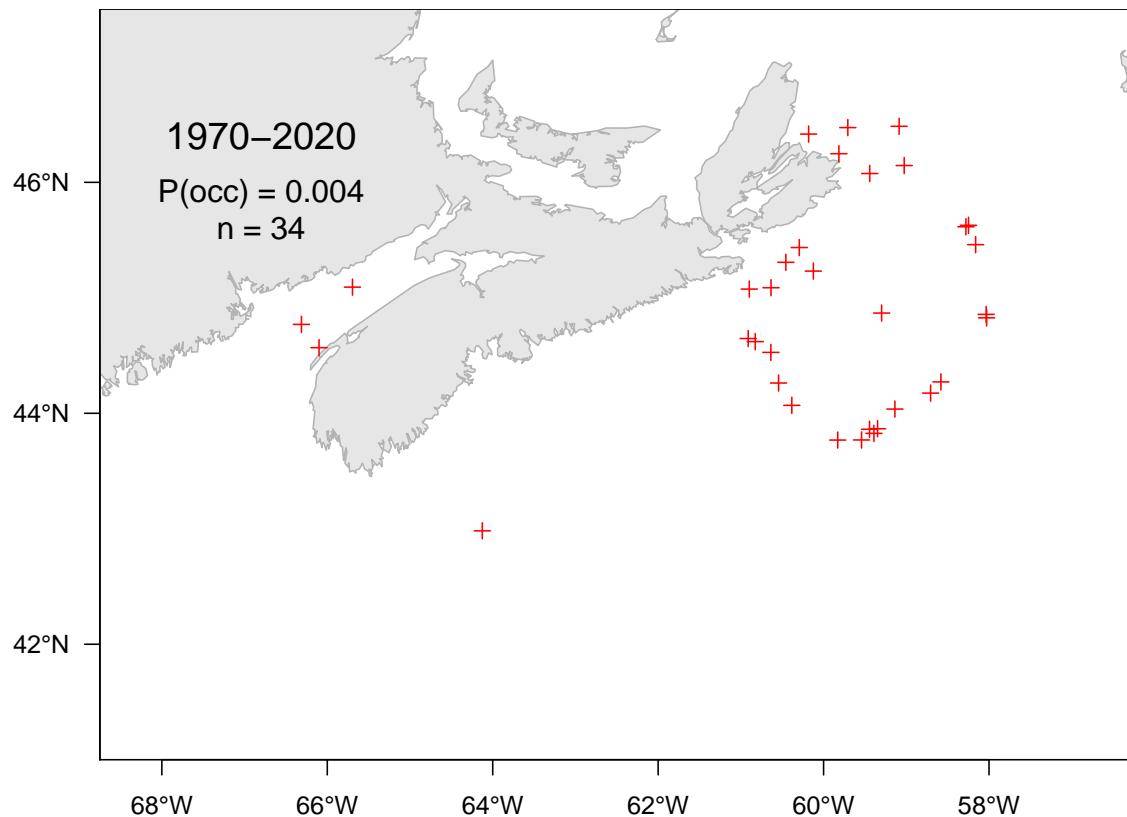


Figure 7.56A. Catch distribution for Atlantic seasnail.

### 7.57 Gelatinous snailfish (Limace gélatineuse) - species code 505 (category LR)

Scientific name: [Liparis fabricii](#)

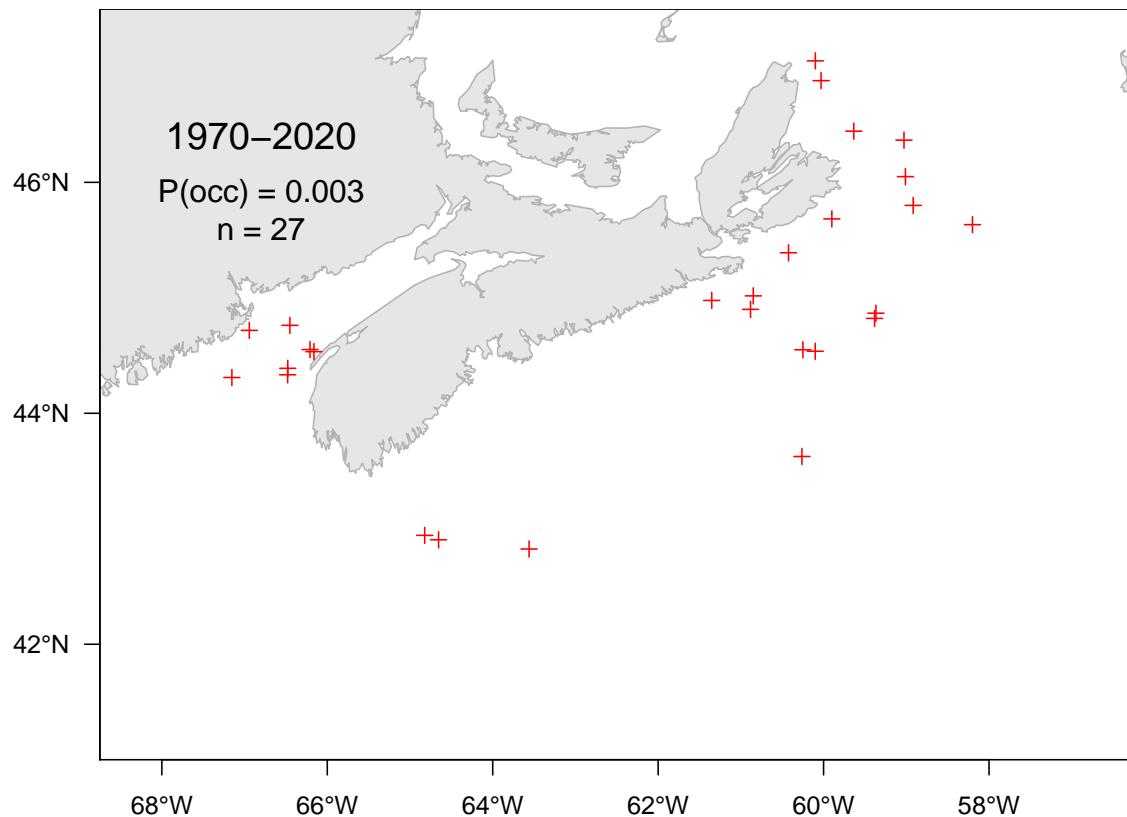


Figure 7.57A. Catch distribution for Gelatinous snailfish.

## 7.58 Variegated snailfish (*Limace marbée*) - species code 512 (category LR)

Scientific name: [Liparis gibbus](#)

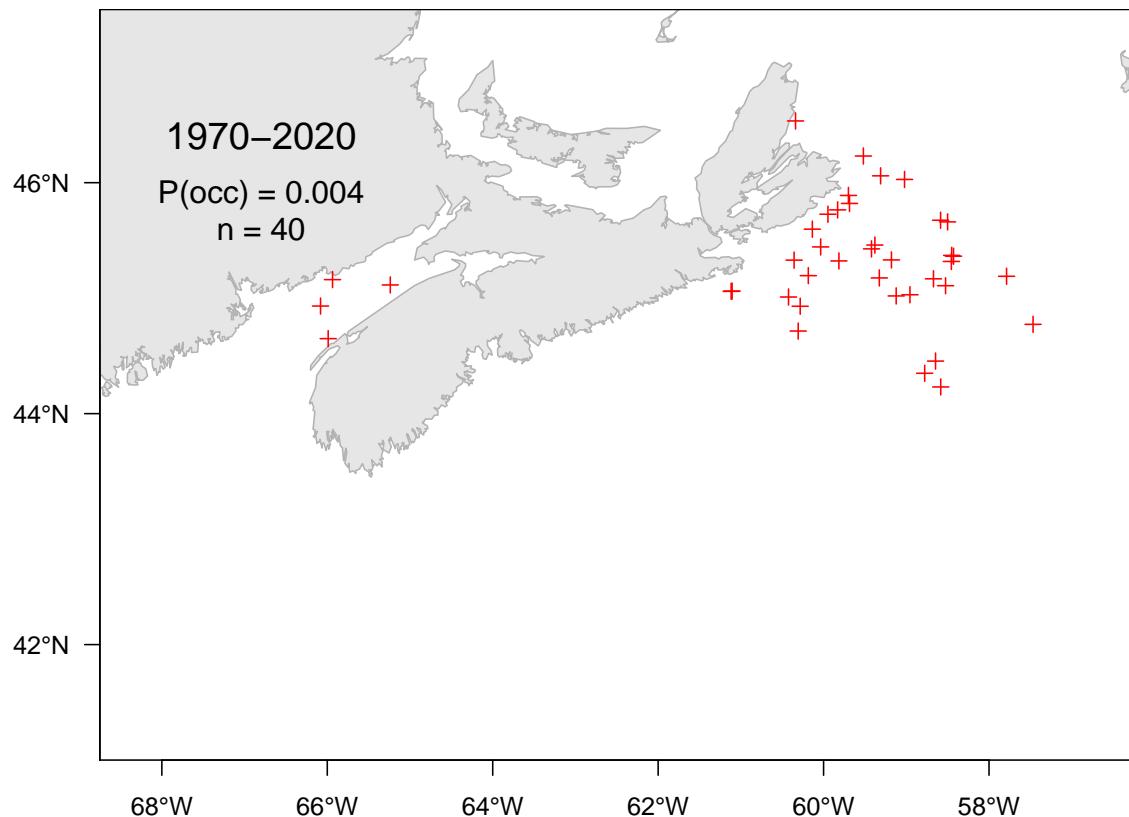


Figure 7.58A. Catch distribution for Variegated snailfish.

## 7.59 Sea tadpole (Petite limace de mer) - species code 520 (category LR)

Scientific name: [Careproctus reinhardtii](#)

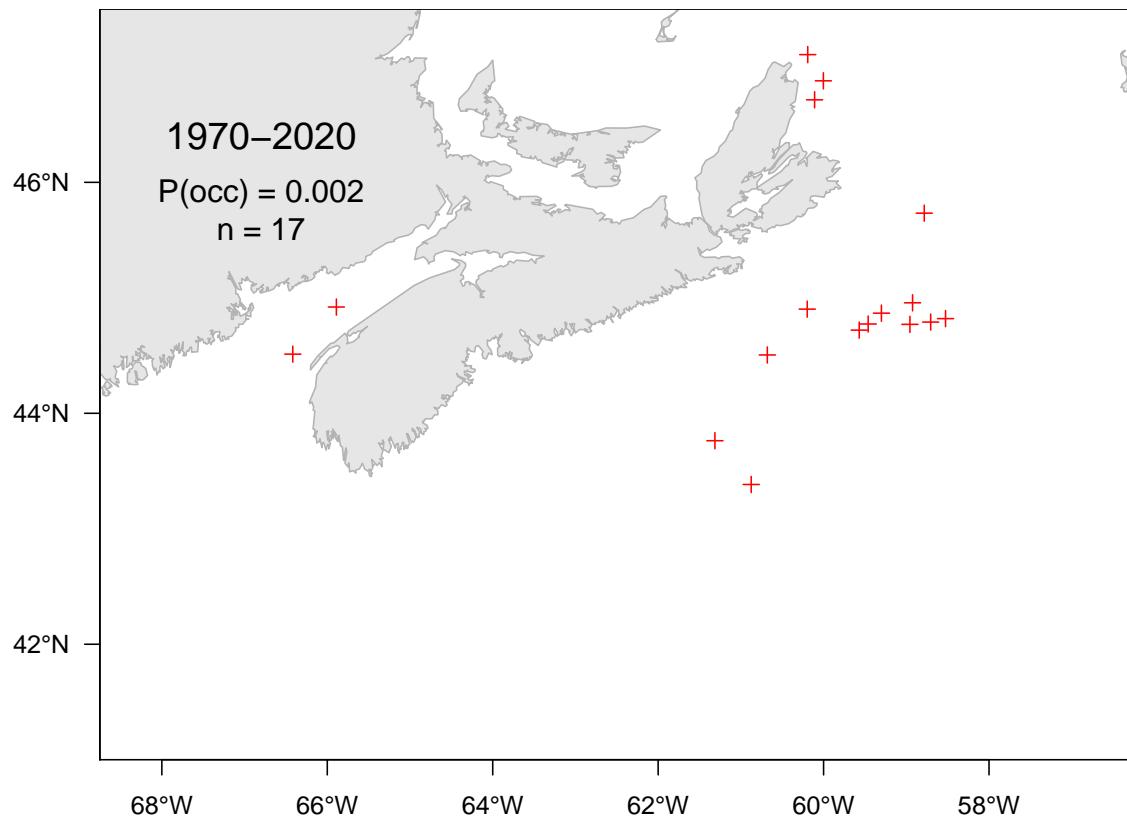


Figure 7.59A. Catch distribution for Sea tadpole.

## 7.60 Wolf eelpout (*Lycodes à tête longue*) - species code 603 (category LR)

Scientific name: [Lycenchelys verrillii](#)

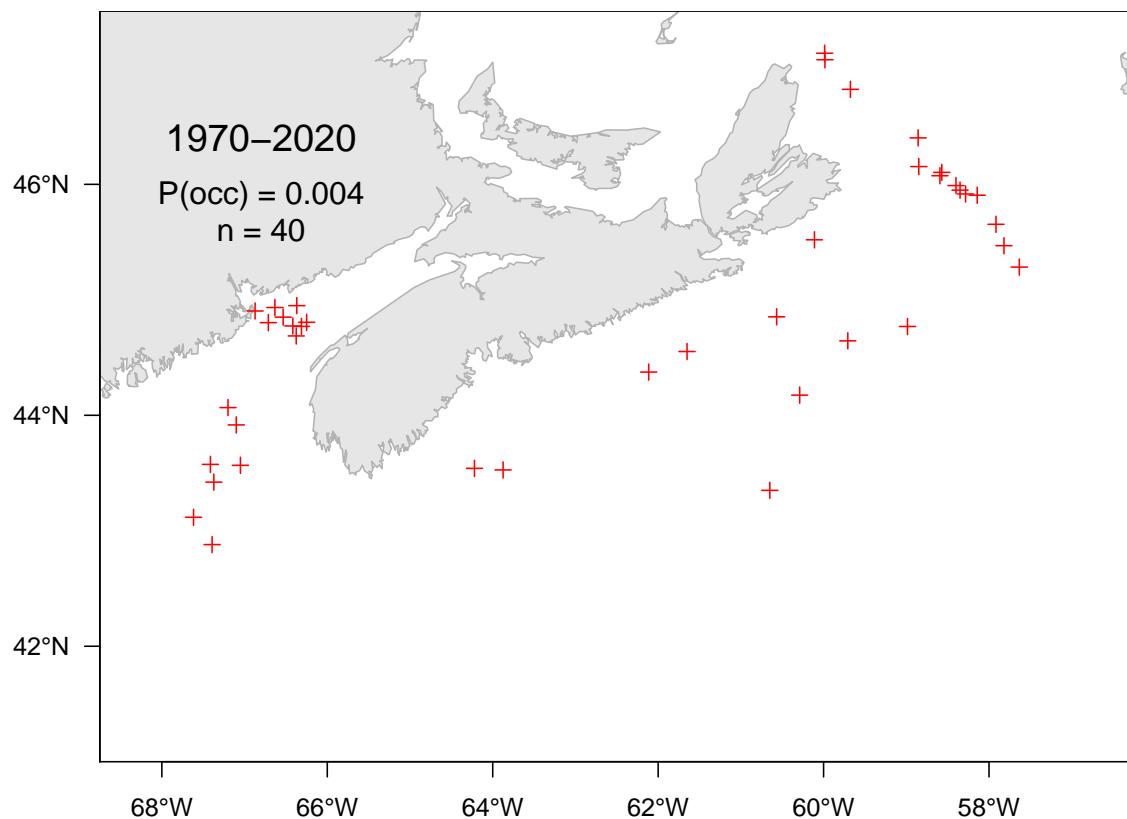


Figure 7.60A. Catch distribution for Wolf eelpout.

### 7.61 Slender snipe eel (Avocette ruban) - species code 604 (category LR)

Scientific name: [Nemichthys scolopaceus](#)

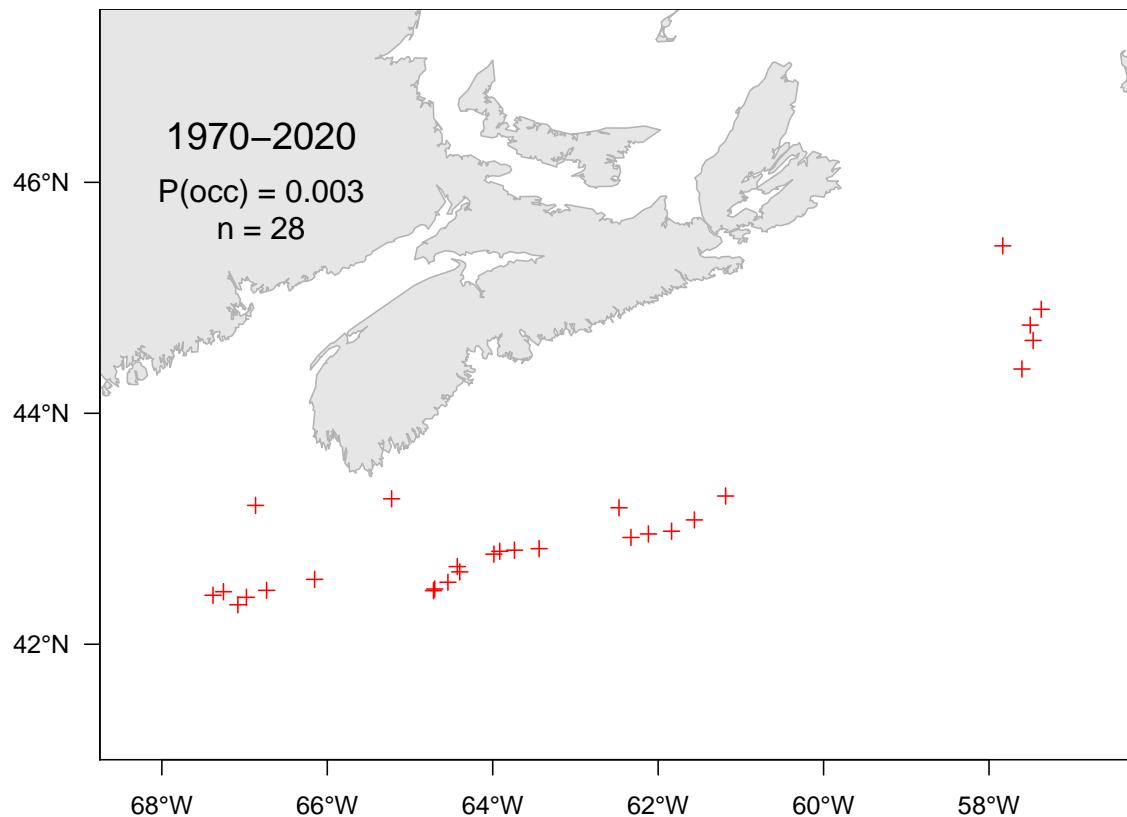


Figure 7.61A. Catch distribution for Slender snipe eel.

## 7.62 Newfoundland eelpout (Lycodes terraenovae) - species code 619 (category LR)

Scientific name: [Lycodes terraenovae](#)

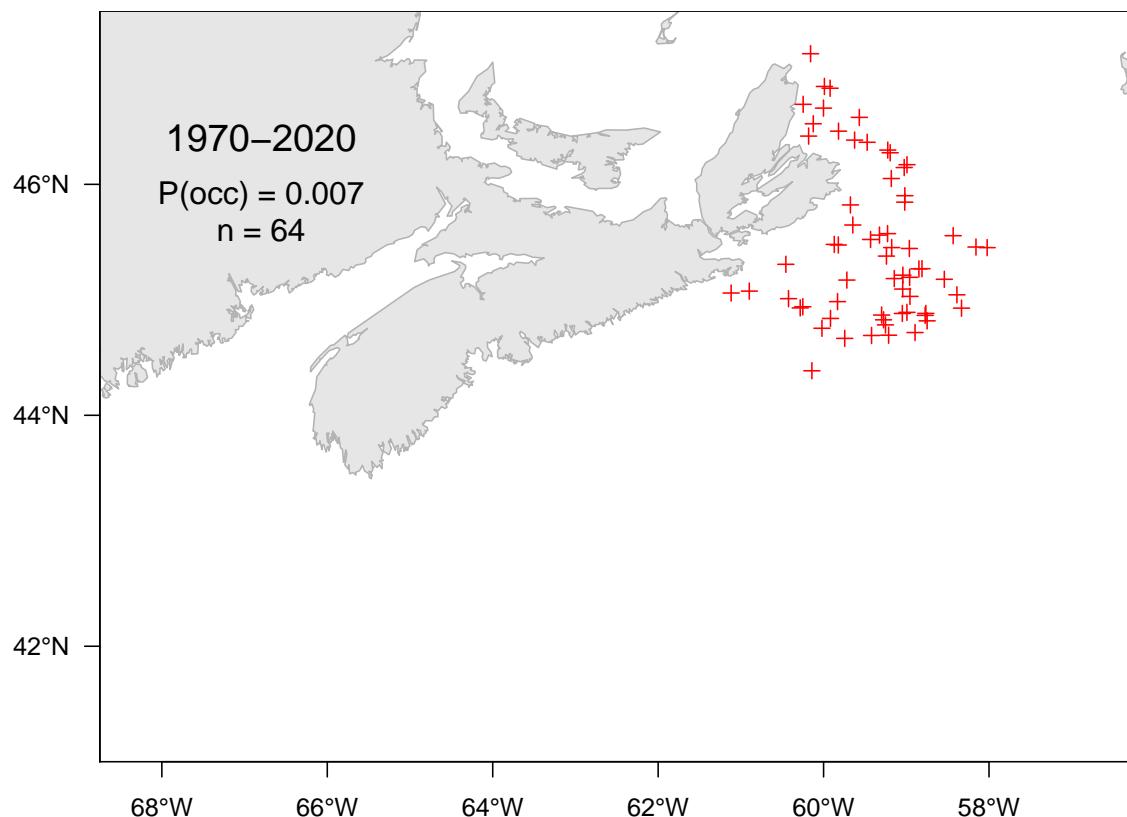


Figure 7.62A. Catch distribution for Newfoundland eelpout.

### 7.63 Newfoundland eelpout (Lycodes du Labrador) - species code 620 (category LR)

Scientific name: [Lycodes lavalaei](#)

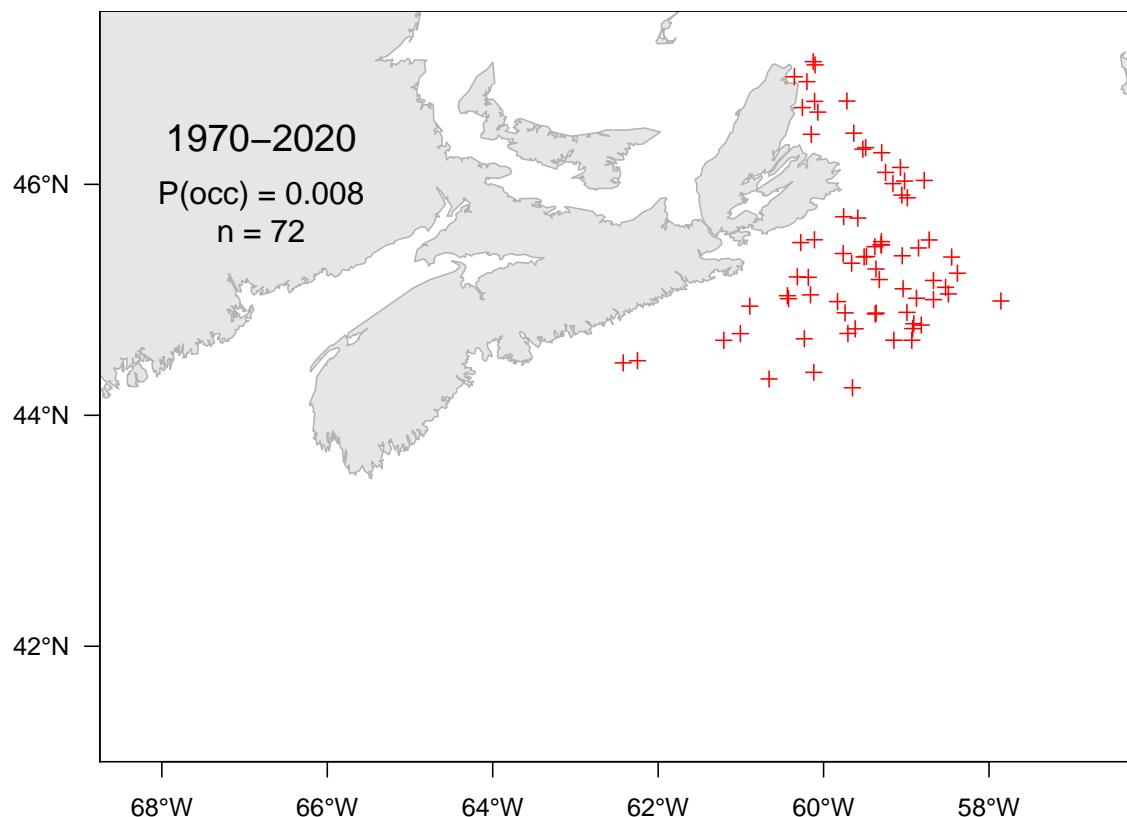


Figure 7.63A. Catch distribution for Newfoundland eelpout.

## 7.64 Rock gunnel (Sigouine de roche) - species code 621 (category LR)

Scientific name: [Pholis gunnellus](#)

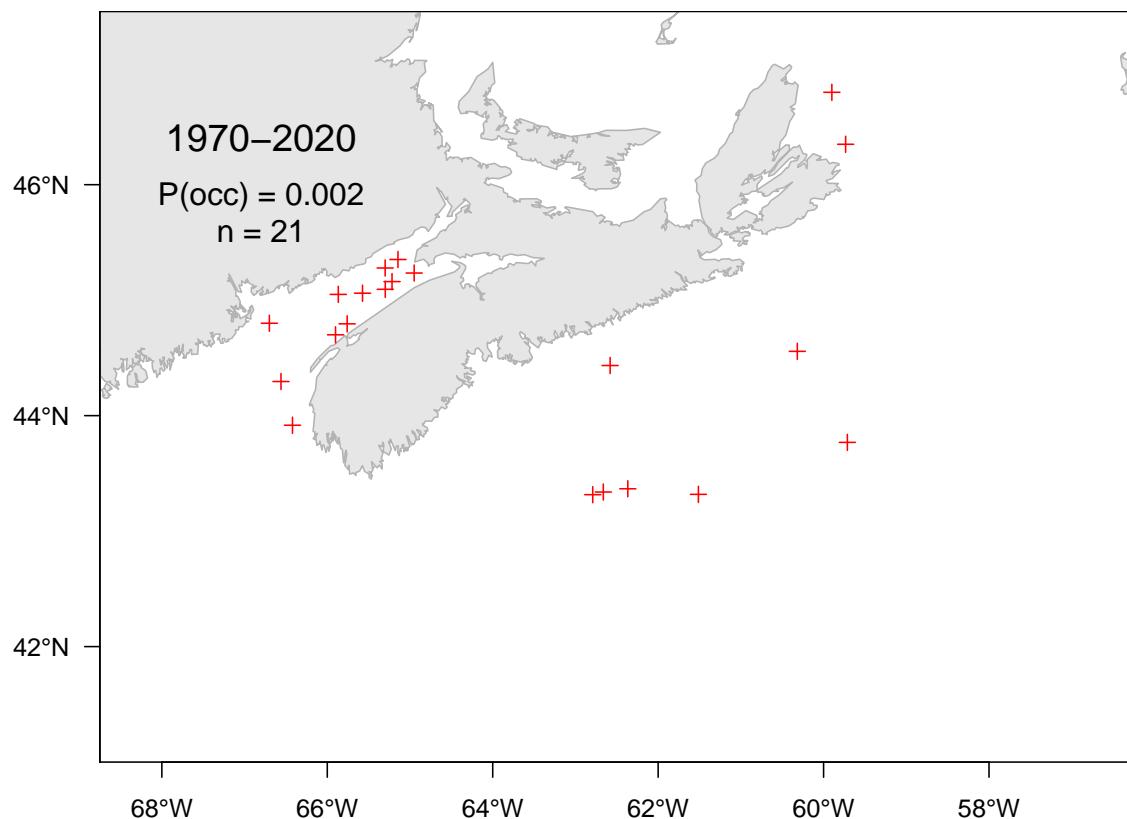


Figure 7.64A. Catch distribution for Rock gunnel.

## 7.65 Radiated shanny (*Ulvaire deux-lignes*) - species code 625 (category LR)

Scientific name: [Ulvaria subbifurcata](#)

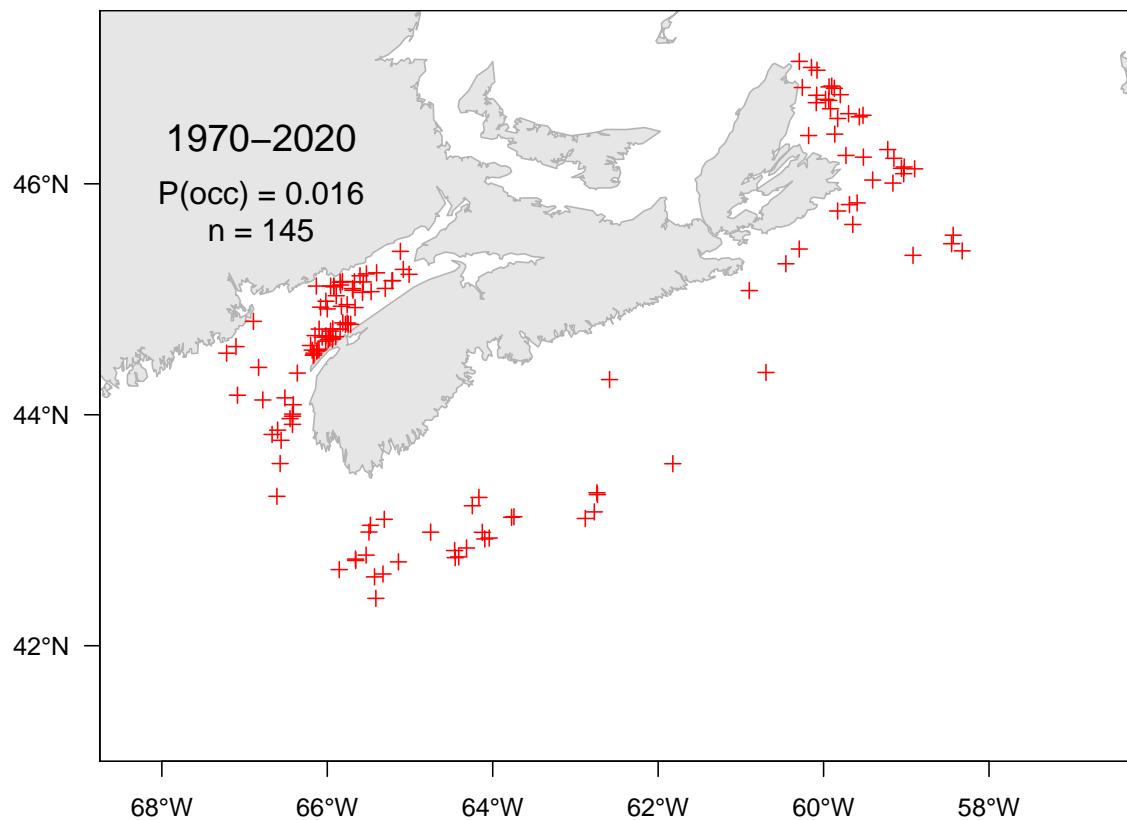


Figure 7.65A. Catch distribution for Radiated shanny.

## 7.66 Fourline snakeblenny (Quatre-lignes atlantique) - species code 626 (category LR)

Scientific name: [Eumesogrammus praecisus](#)

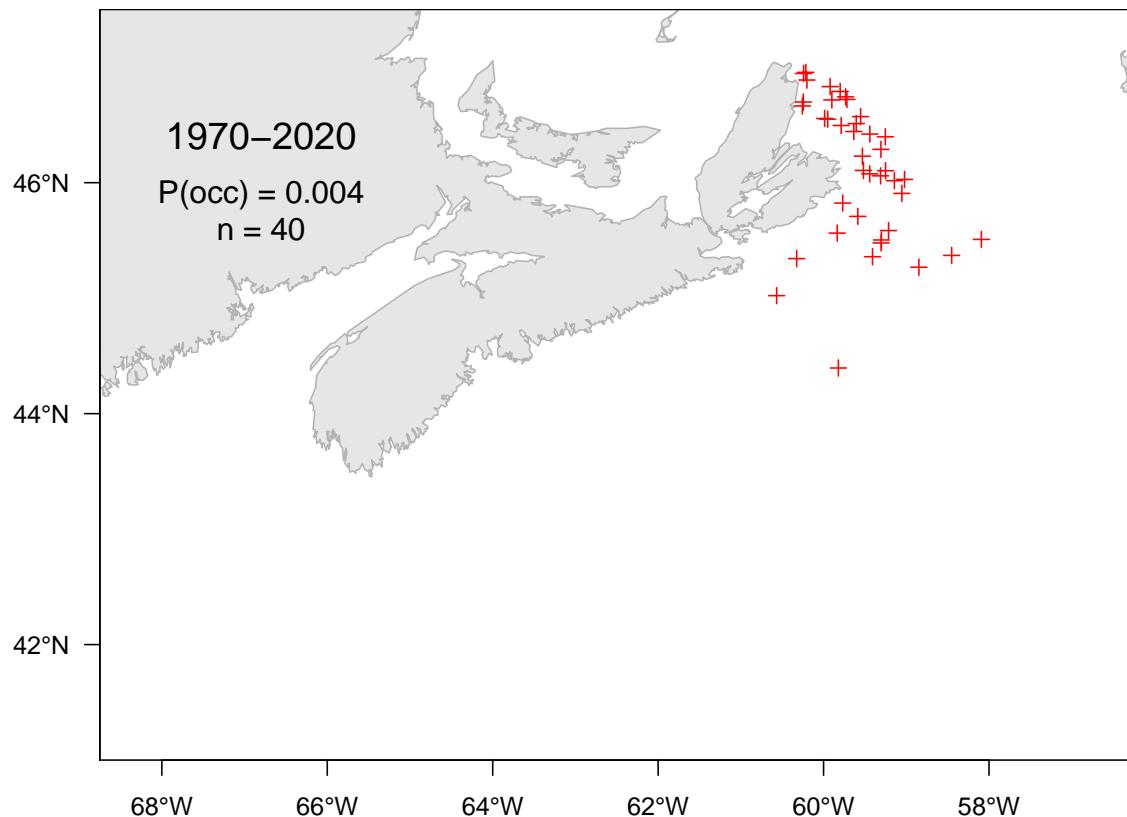


Figure 7.66A. Catch distribution for Fourline snakeblenny.

### 7.67 Wrymouth (Terrassier tacheté) - species code 630 (category LR)

Scientific name: [Cryptacanthodes maculatus](#)

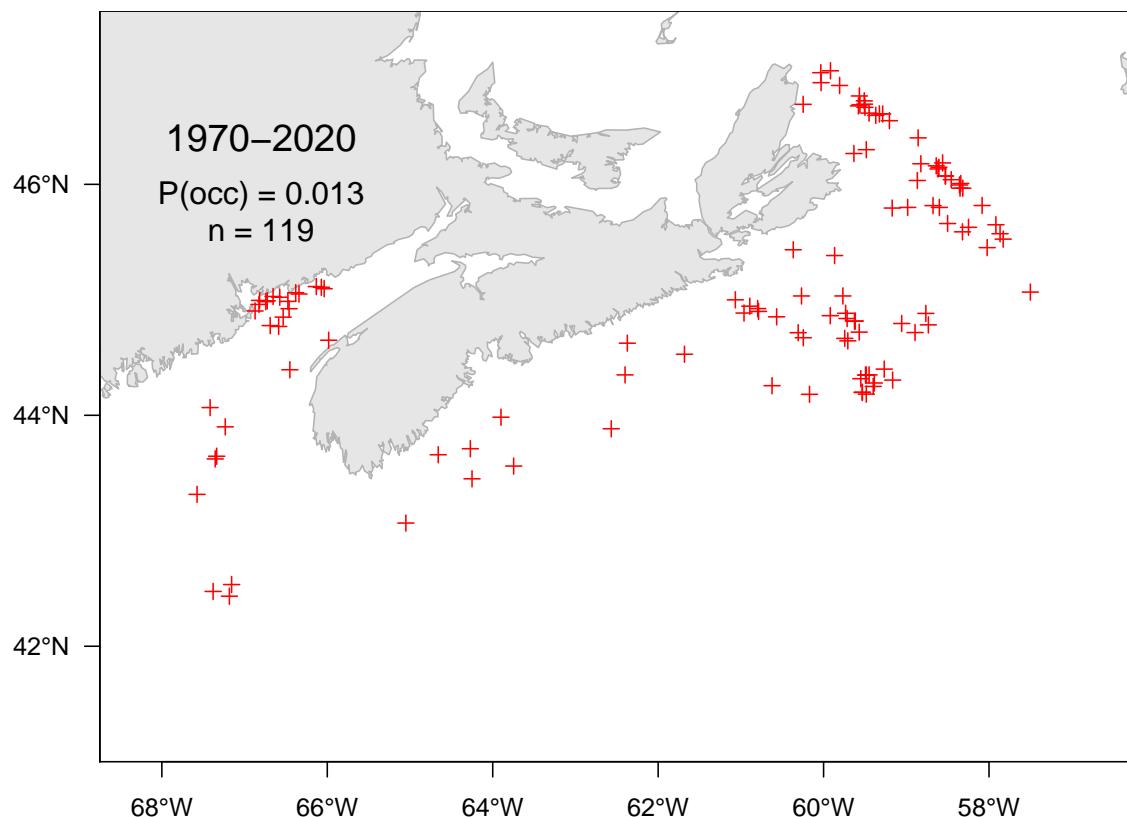


Figure 7.67A. Catch distribution for Wrymouth.

## 7.68 Spotfin dragonet (Dragonnet tacheté) - species code 637 (category LR)

Scientific name: [Foetorepus agassizii](#)

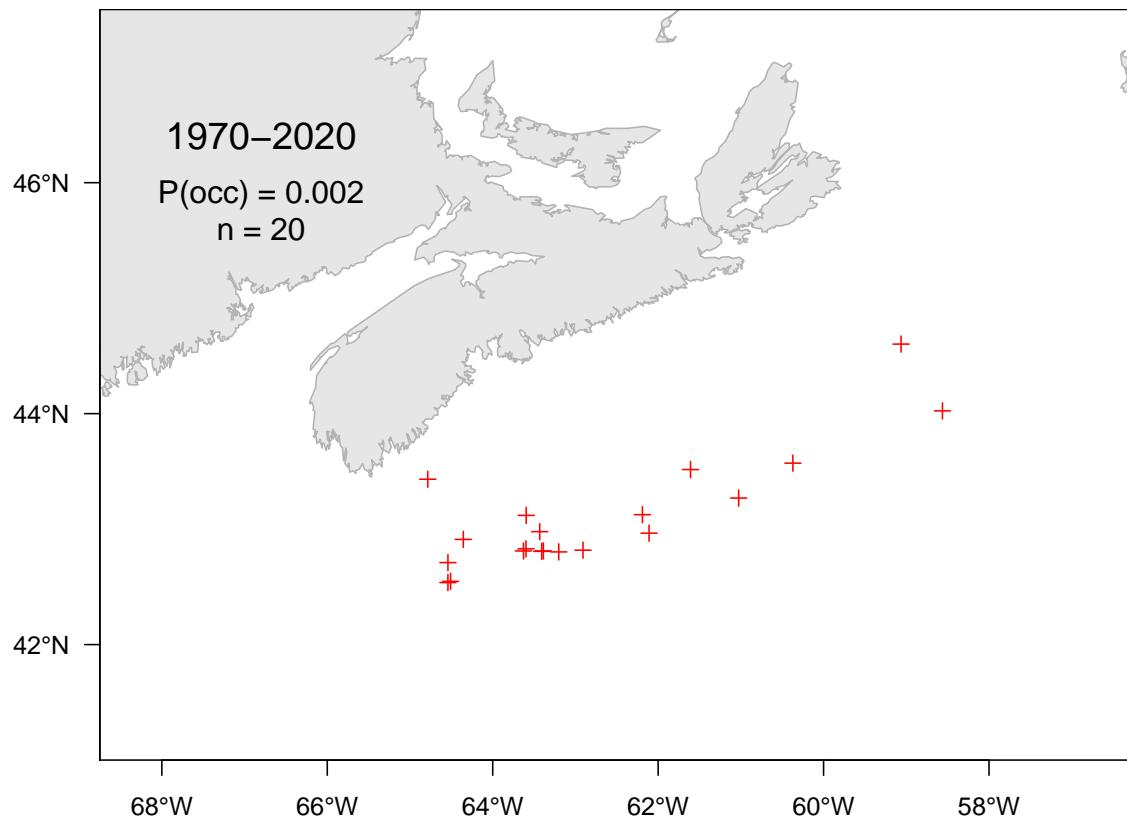


Figure 7.68A. Catch distribution for Spotfin dragonet.

### 7.69 Arctic eelpout (*Lycodes arctique*) - species code 641 (category LR)

Scientific name: [Lycodes reticulatus](#)

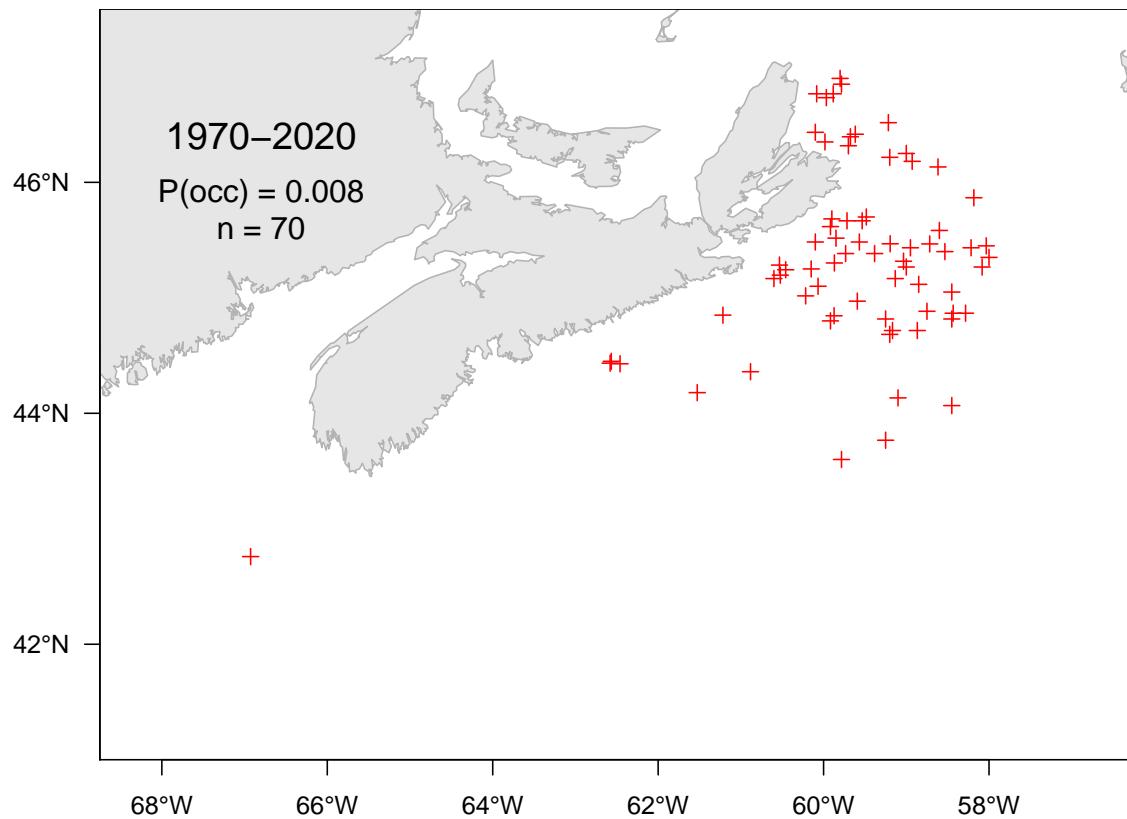


Figure 7.69A. Catch distribution for Arctic eelpout.

## 7.70 Atlantic soft pout (*Molasse atlantique*) - species code 646 (category LR)

Scientific name: [Melanostigma atlanticum](#)

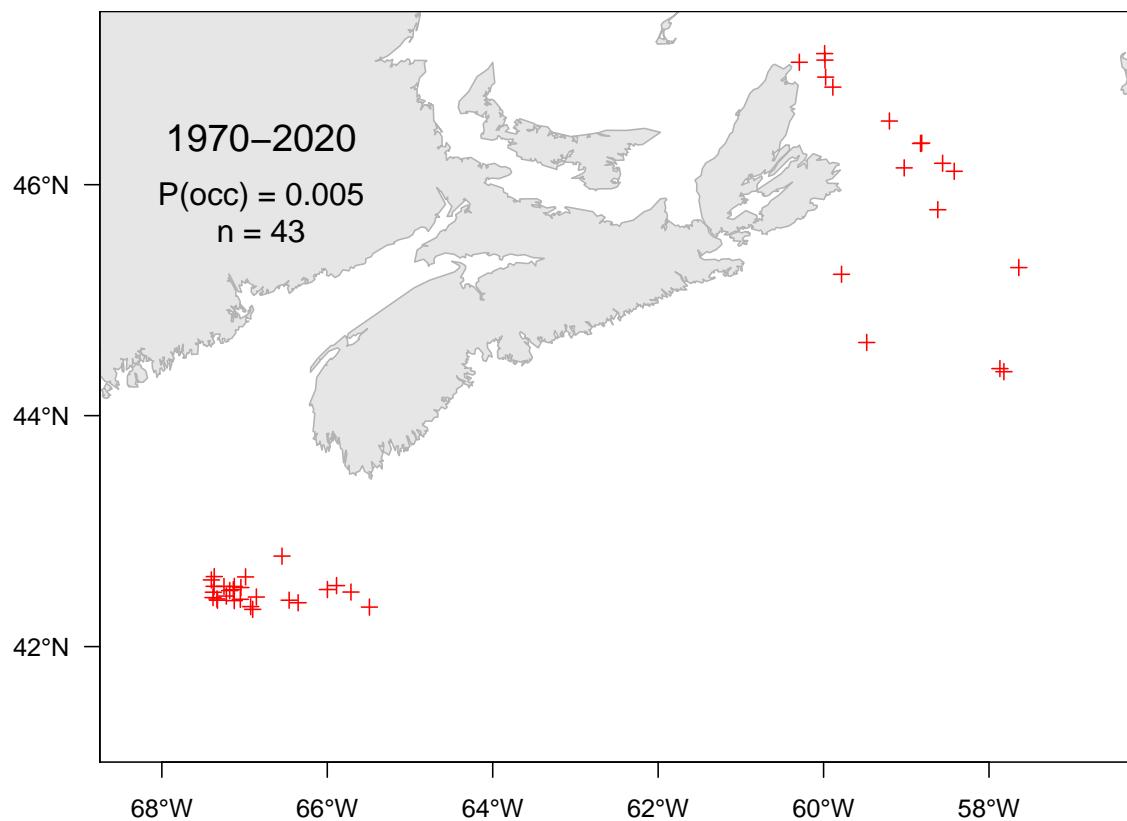


Figure 7.70A. Catch distribution for Atlantic soft pout.

### 7.71 Silvery John dory (Saint Pierre argenté) - species code 704 (category LR)

Scientific name: [Zenopsis conchifer](#)

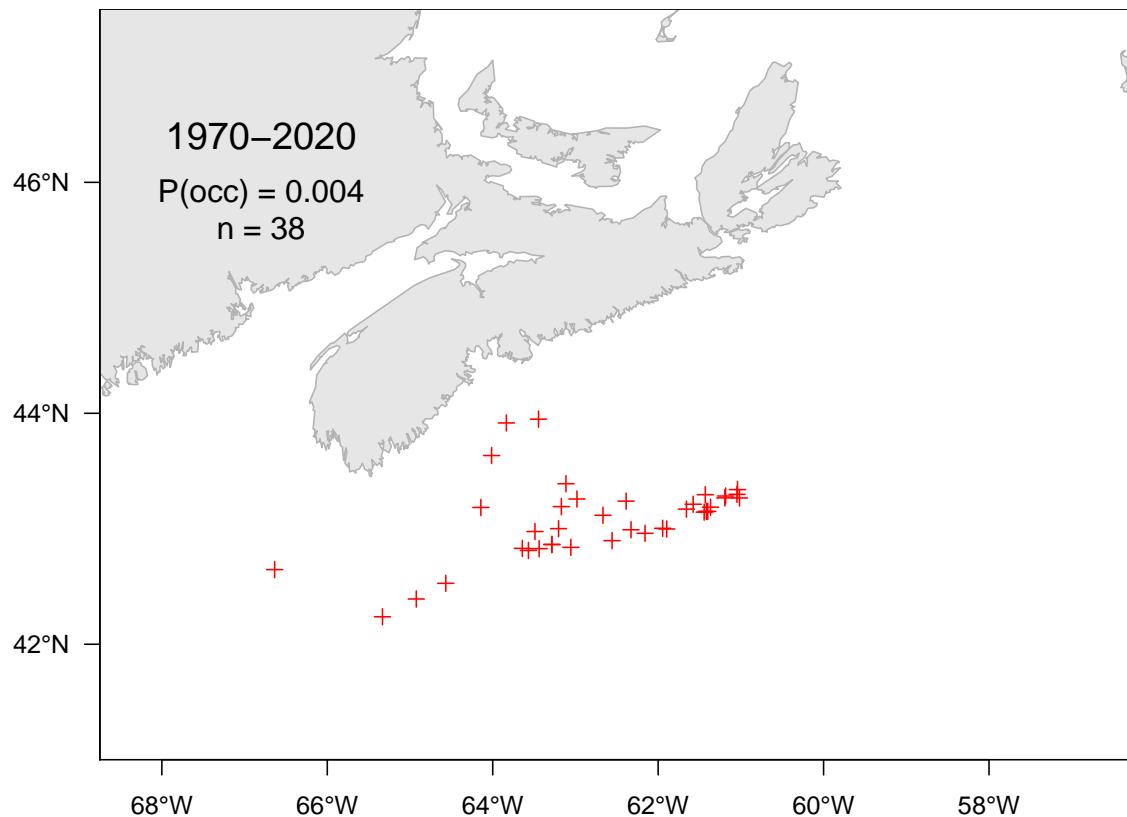


Figure 7.71A. Catch distribution for Silvery John dory.

## 7.72 White barracudina (*Lussion blanc*) - species code 712 (category LR)

Scientific name: [Arctozenus risso](#)

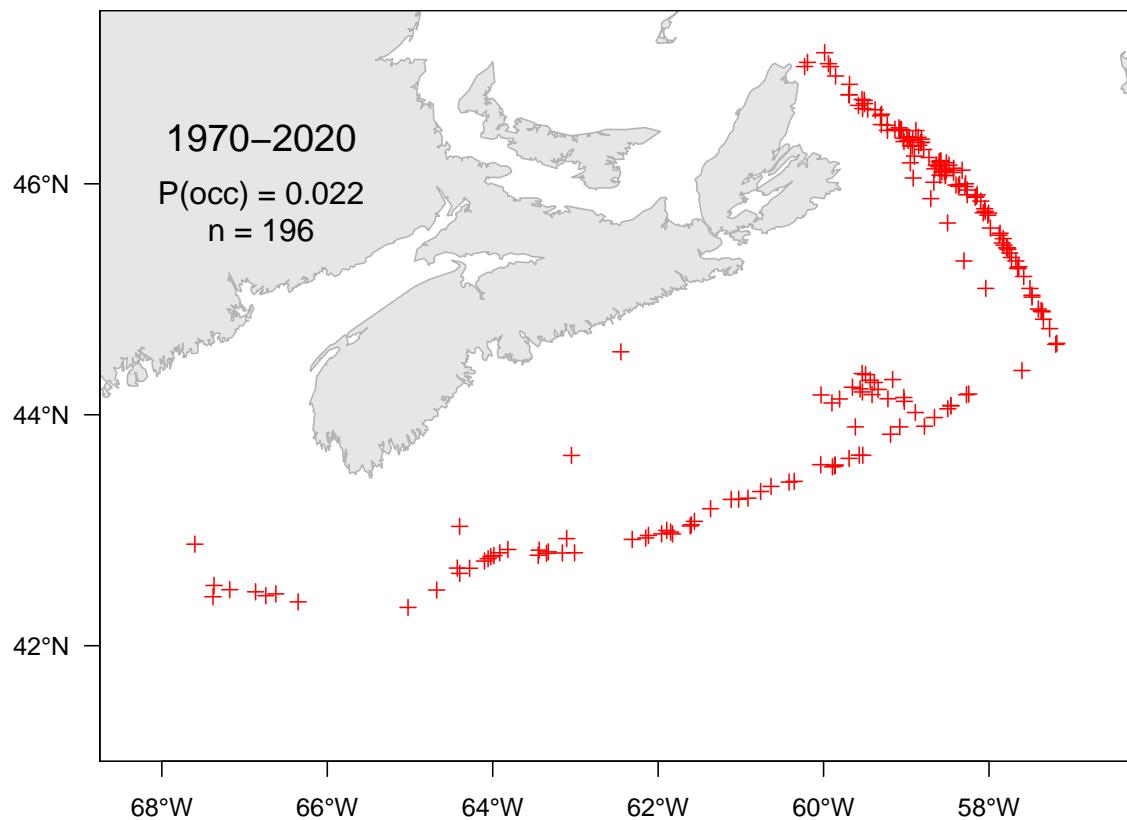


Figure 7.72A. Catch distribution for White barracudina.

### 7.73 Atlantic saury (Balaou atlantique) - species code 720 (category LR)

Scientific name: [Scomberesox saurus](#)

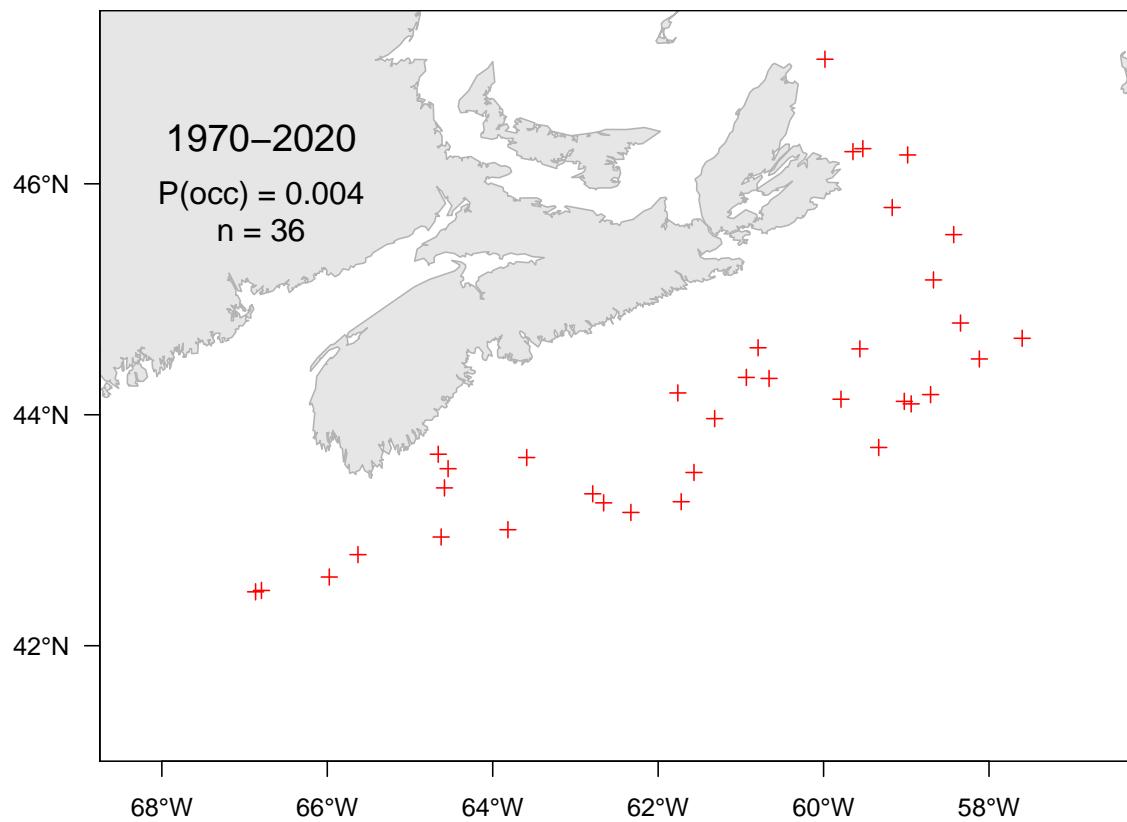


Figure 7.73A. Catch distribution for Atlantic saury.

## 7.74 Hatchetfishes (Haches d'argent) - species code 741 (category LR)

Scientific name: [Sternopychidae](#)

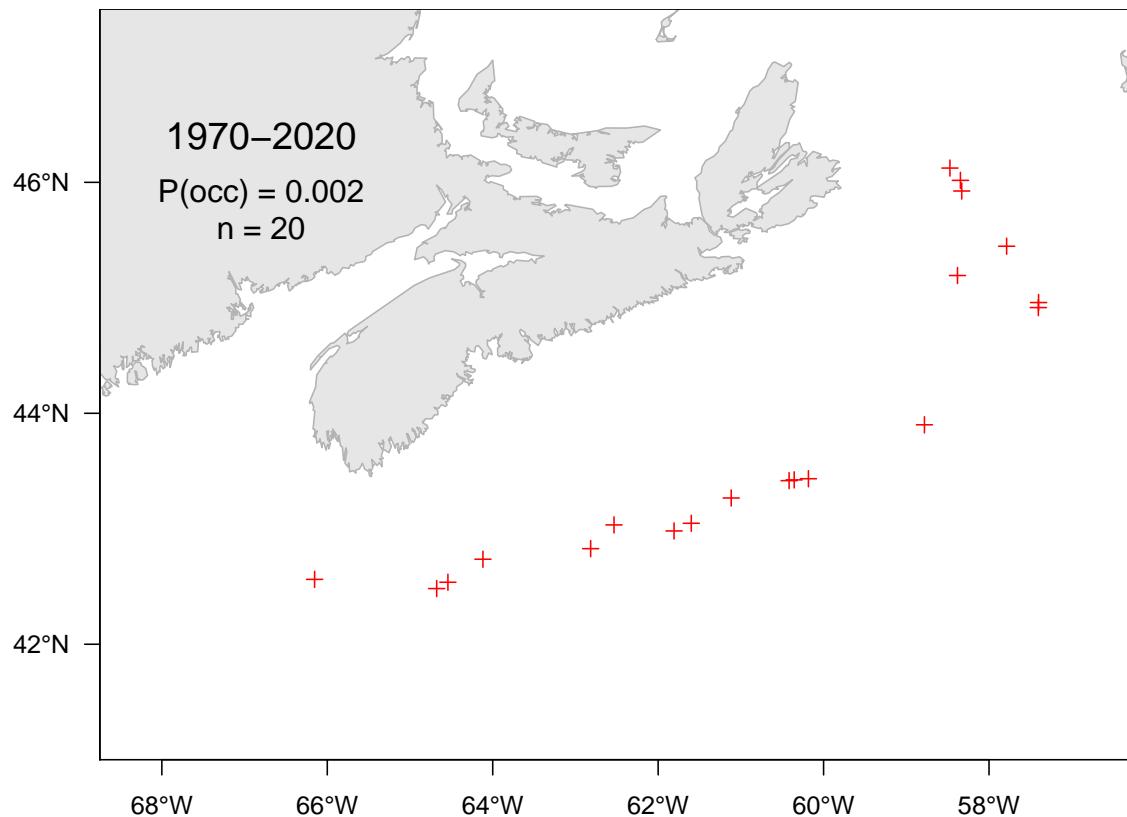


Figure 7.74A. Catch distribution for Hatchetfishes.

### 7.75 Atlantic batfish (*Malthe atlantique*) - species code 742 (category LR)

Scientific name: [Dibranchus atlanticus](#)

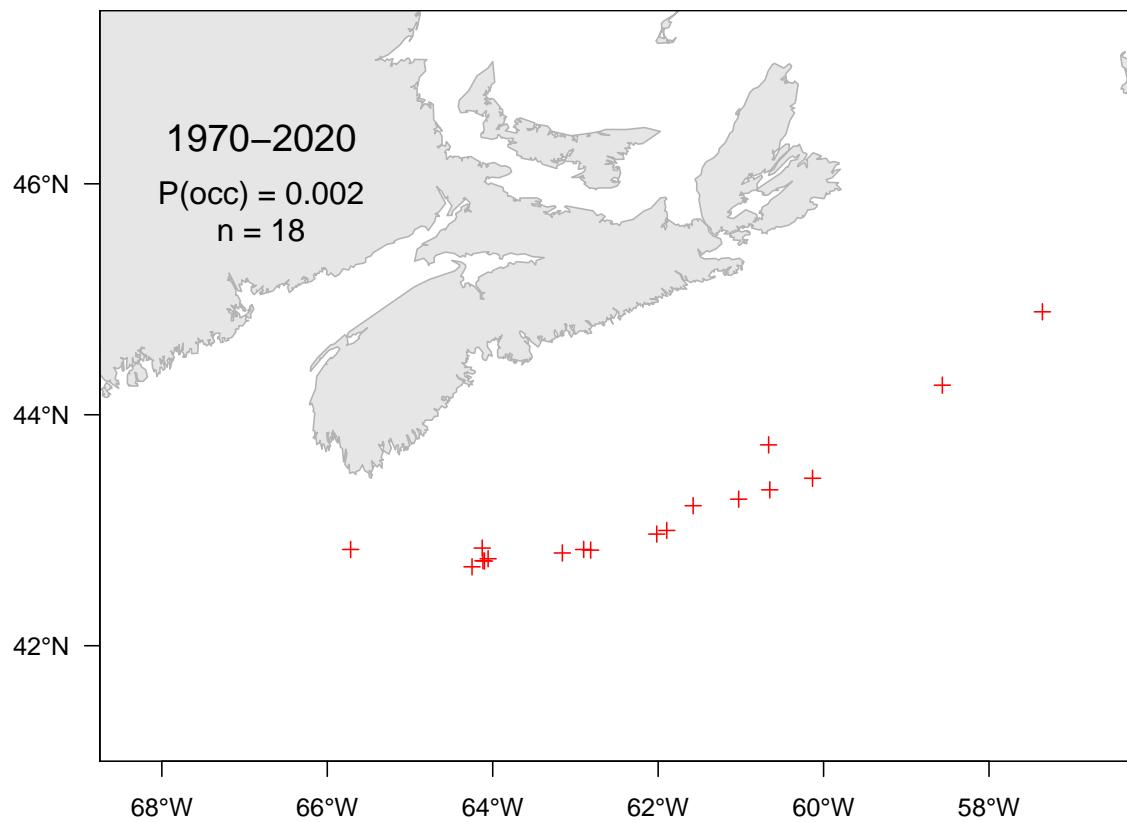


Figure 7.75A. Catch distribution for Atlantic batfish.

## 7.76 Spottedfin tonguefish (Langue fil noir) - species code 816 (category LR)

Scientific name: [Symphurus diomedeanus](#)

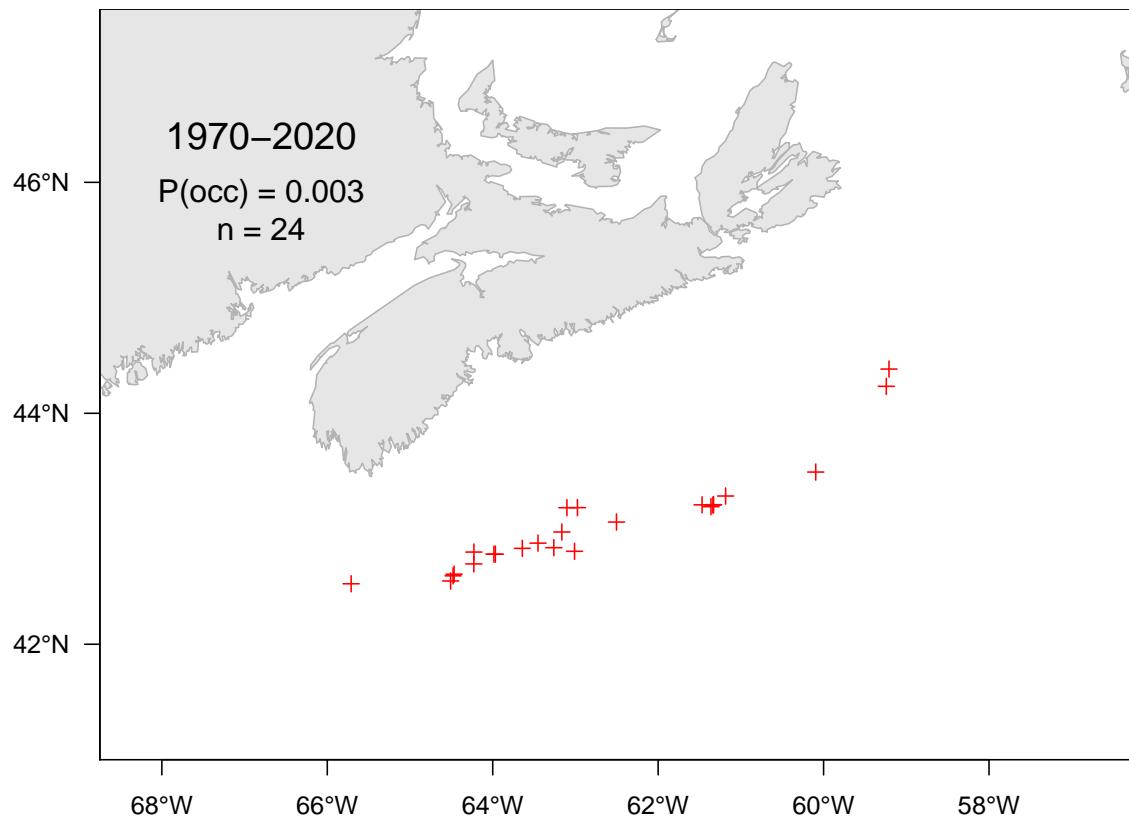


Figure 7.76A. Catch distribution for Spottedfin tonguefish.

### 7.77 Black dogfish (Aiguillat noir) - species code 221 (category LR)

Scientific name: [Centroscyllium fabricii](#)

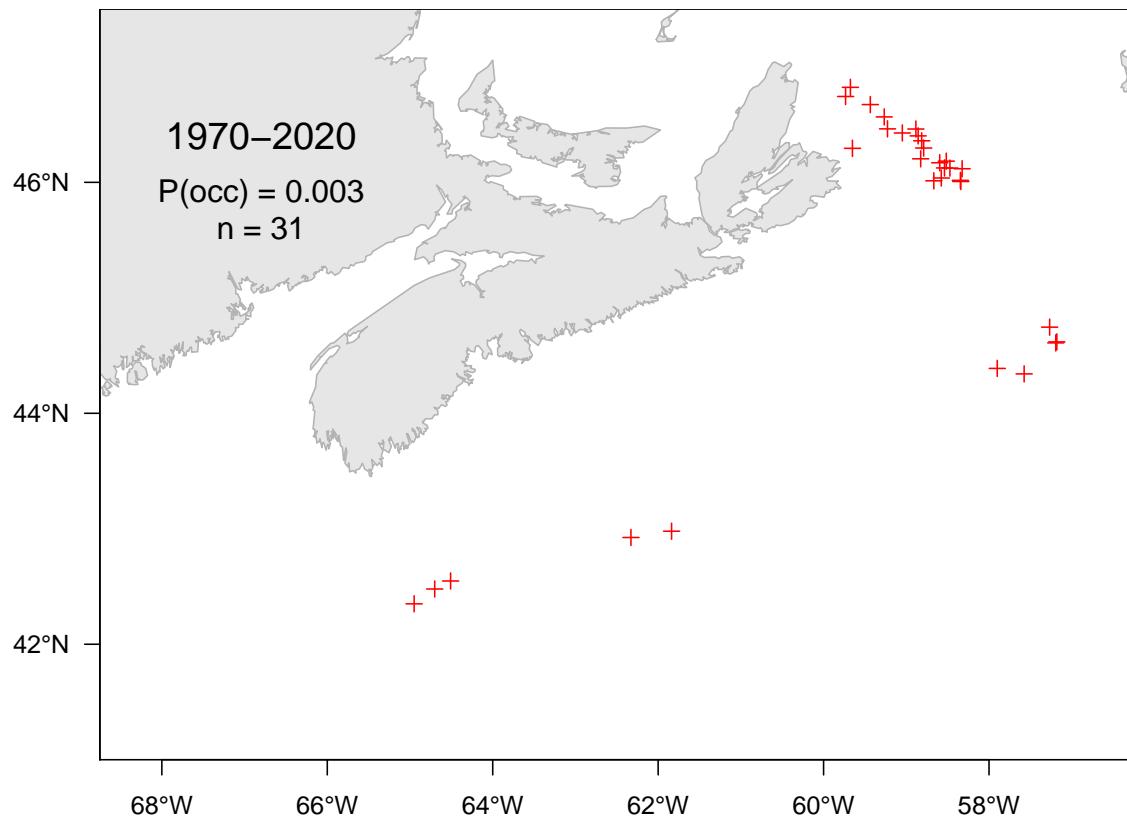


Figure 7.77A. Catch distribution for Black dogfish.

## 7.78 Longfin inshore squid (Calmar totam) - species code 4512 (category LR)

Scientific name: [Doryteuthis pealeii](#)

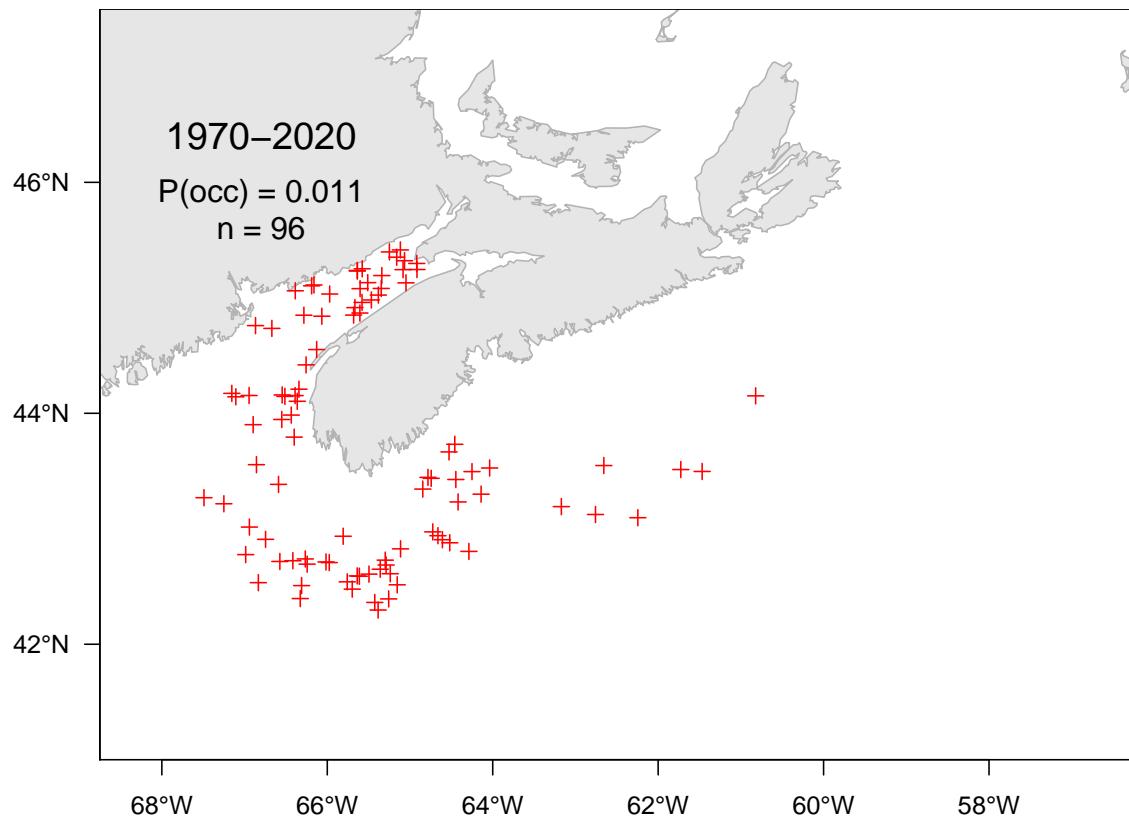


Figure 7.78A. Catch distribution for Longfin inshore squid.

## 7.79 Red deepsea crab (Crabe rouge) - species code 2532 (category SR)

Scientific name: [Chaceon quinquedens](#)

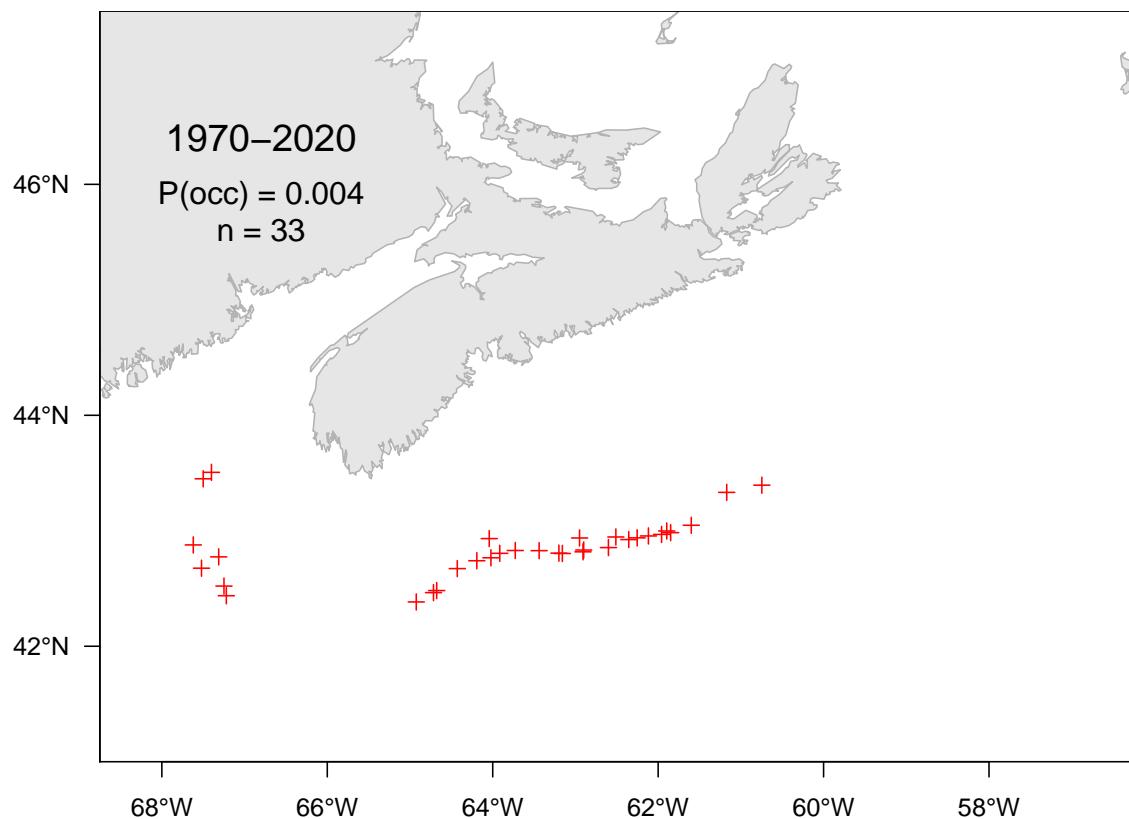


Figure 7.79A. Catch distribution for Red deepsea crab.

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